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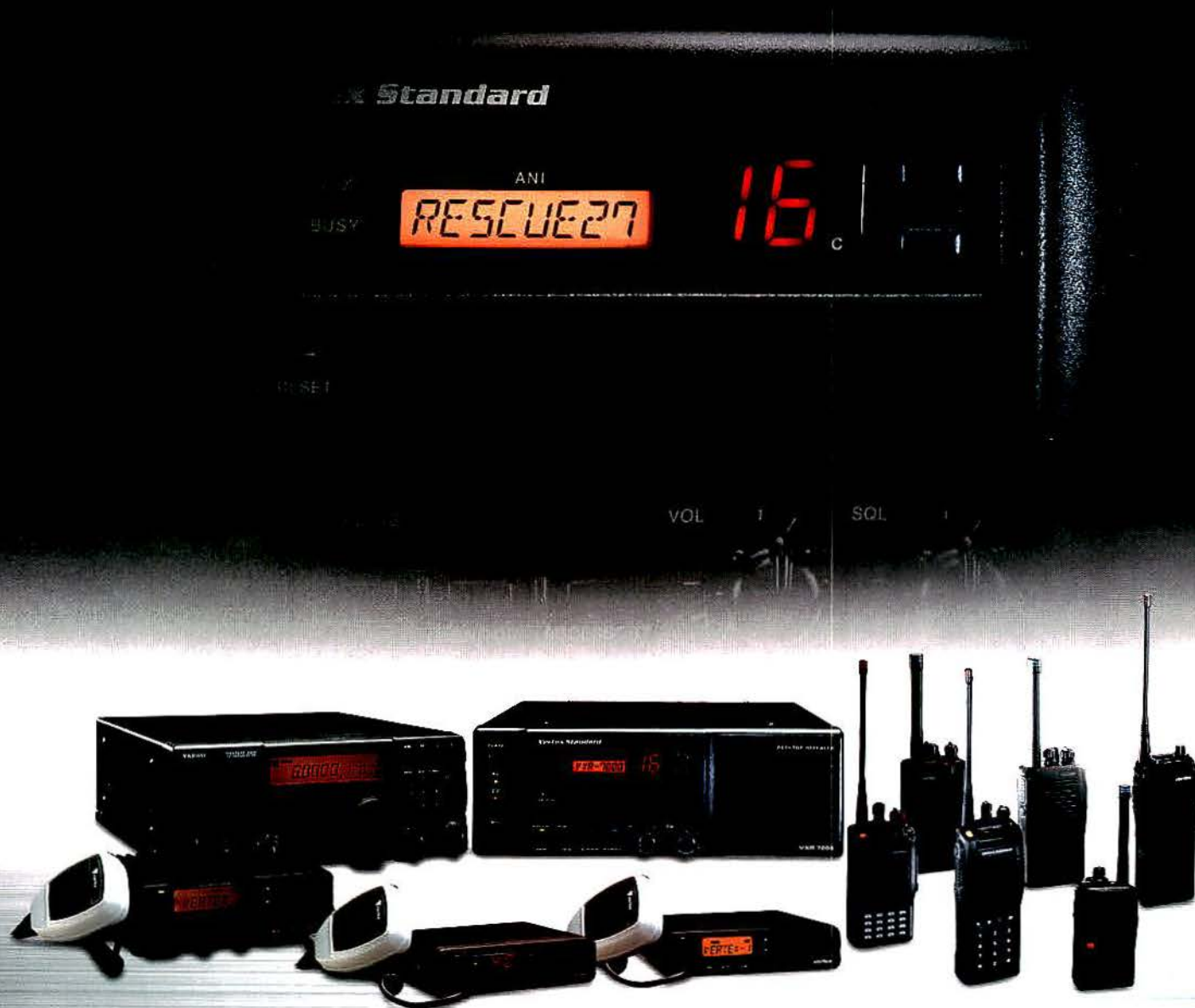
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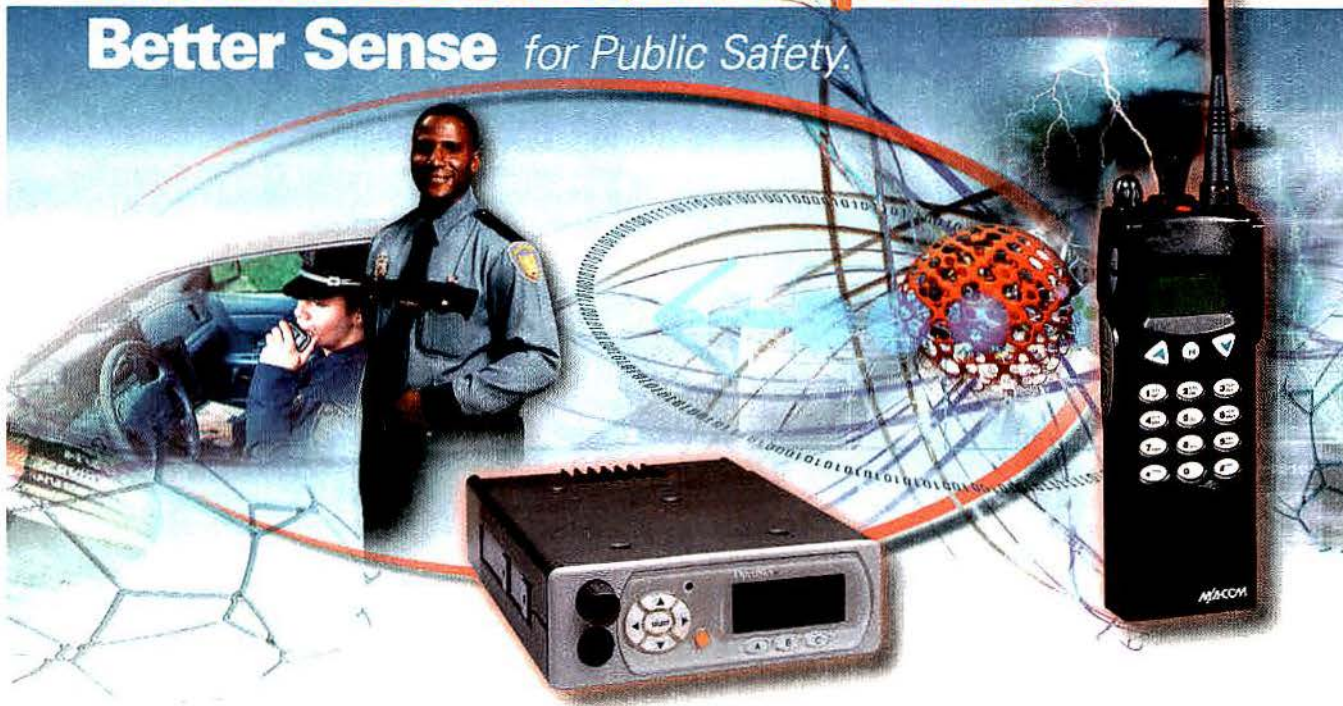
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On the cover: Despite the destruction to New York on Sept. 11, emergency workers continued to do their jobs. See page 28. Cover photo by Michael Coppola.

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MOBILE RADIO
TECHNOLOGY

NOVEMBER 2001

Volume 19, Issue 11



When analyzing digital radio systems, examine their modulation schemes closely. See page 42.



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-  **Special report: 220MHz**
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NY, DC attacks underscore dedication, sacrifice

Many stories are emerging from the Sept. 11 atrocity in which hijackers took the lives of hundreds of airline passengers



along with thousands more in New York and Washington.

At least 25,000 people were evacuated safely from the New York World Trade Center. Nearly 5,500 people were killed or are missing and 8,700 were injured in New York; in Washington, DC; and Pennsylvania.

Hundreds of members of the Fire Department of New York responded, including firefighters, fire officers, paramedics, emergency medical technicians and others. Thirty-four members of the department have been confirmed as killed in the line of duty. Another 309 members are missing. Another 186 members were injured, with nine still hospitalized as of this writing, some in critical condition.

Twenty-three members of the New York Police Department are listed as having died in the line of duty.

We have no way to number other public safety workers and citizen volunteers who may have been sacrificed or injured while assisting in evacuations, including Port Authority of New York and New Jersey police, security and other staff working at the World Trade Center, and Pentagon employees. What is certain is that many thousands survived the fires and rapid building

collapses thanks in large measure to well-trained, dedicated and selfless public safety workers.

Our mission in publishing our magazine and Web site is to gather and disseminate information that helps radio communications professionals in a variety of ways based on technology, operations and regulation. The radio communications perspective is a small, yet important, piece of the greater story of efforts to cope with the immediate emergency and the following recovery connected with the losses of Sept. 11. In focusing our coverage on that aspect, we do our job.

As we go about that job, we are humble in our recognition of sacrifices made by members of the Fire Department of New York, the New York Police Department, other public safety agencies and volunteers in their immediate response to the World Trade Center disaster. We are grateful for their dedication and courage, and we offer our sympathy to those who were injured and to the families, friends and colleagues of those who were lost.

Last month's issue went to press at the same time news was breaking about the attacks on New York and Washington. This issue is going to press as news is breaking about American and British armed forces launching a coordinated attack on Taliban-controlled military installations and on Al Qaeda-operated training camps in Afghanistan, along with an airlift of food and medical supplies for the Afghan people. We hope for the safety of the U.S. military and those of American allies as they are placed in harm's way to stop the forces of terrorism.

Don Bishop

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Attacks affect industry

For more in-depth coverage see

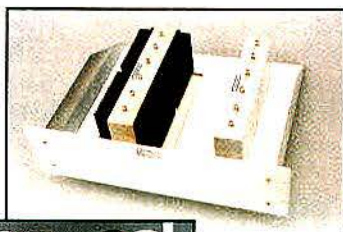
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- ❑ From Fire Department Dispatch: A First-person Account, by Frank Raffa
- ❑ Terrorist Attacks Fall on National 9-1-1 Day
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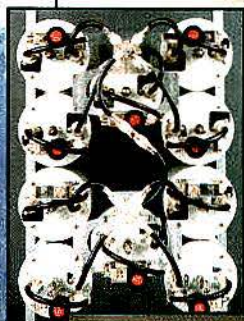
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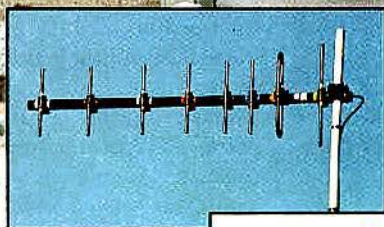
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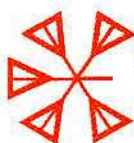


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Fire departments lack technological advances for communications

For the first time in my 12-year professional career as a firefighter, a civilian has hit the nail on the head with observations about my job.

As both a firefighter and commu-

nications director for the department I serve, I took great interest in your article ("Save the Heroes," *Making Waves*, August 2001). We indeed are faced with sometimes impossible

odds but we succeed in most cases.

The part we continue to fail at is the ability to affect the purchasing habits of our municipalities. We are often left without the latest technological advances to enhance our ability to do the job.

Communications equipment is no exception. With infrastructure costs as high as they are for new technologies such as the 800MHz and 900MHz trunking systems, it makes achieving these "necessities" difficult. As one who specs, installs and maintains communications systems, I have found my greatest obstacle is the almighty dollar, not finding the technology to solve a problem. It is only in recent months that we have upgraded our system to the late 1970s VHF repeater system. This replaced the 1960s simplex system. What a move.

It is also only in recent years that 75% of our personnel have portable radio availability. Only 100% is acceptable and it may be yet another year before that may be achieved.

While we do face inherent risks in the line of duty each day, the need for funding to reduce that risk is not always available. The Bush Administration saw it fit to reduce FIRE ACT grant funding by \$200 million. Much of those monies cut could have been used for communications systems upgrades.

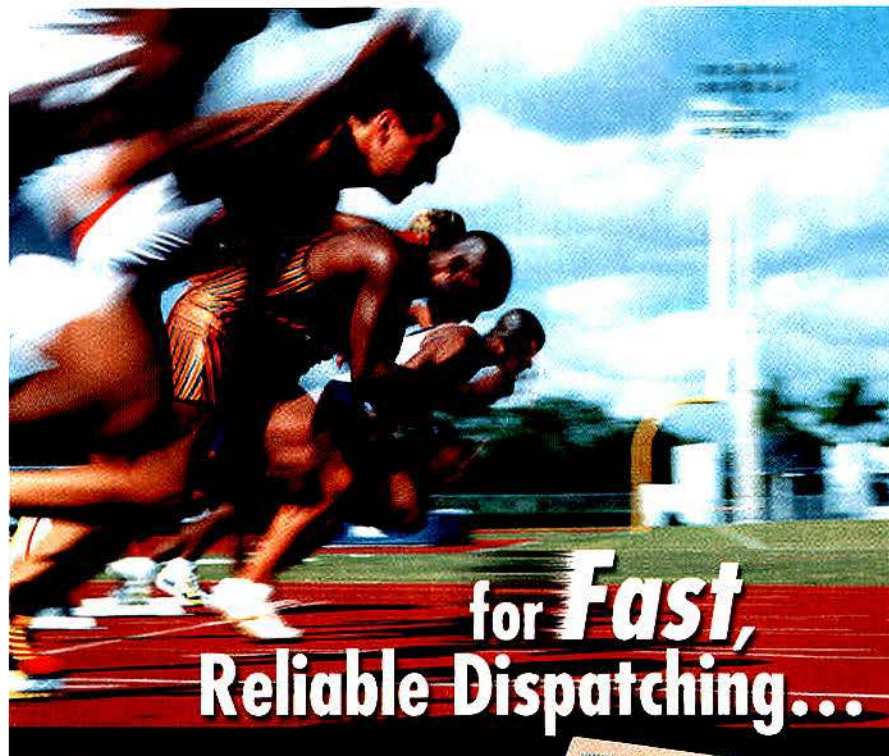
Perhaps it is time that the federal government begin taking an active role in protecting our "nation's first responders" by ensuring higher standards for communications in the public safety sectors. Thanks so very much for your article and keep up the good work.

—FF. Jeff Weidner
Communications

City of Kenosha Fire Department
Kenosha, WI

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For more letters, go to MRT's Web site and click on "Letters from Readers" (under "Site Features").



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Making Waves

Amateur standings

A recurring problem in the news biz is that what interests *some* of your readers doesn't necessarily interest *all* your readers. Years



ago, when I was a suburban newspaper editor, a reader complained that no local paper devoted any space to the amateur duck-pin bowling league. This sport engaged the avid attention of about 20 people in a circulation area of about 250,000.

I explained that most people wanted stories about their kids on the high school teams to appear in the space we had available. Of course, the rejoinder to that was "Well, how is it ever going to get popular if nobody prints anything about it?"

You go with your core competency. *MRT's* primary mission is land-mobile infrastructure for CMRS, private business networks and public safety. Even with that elite readership, you can't please everyone.

How to install a police radio control head in a Crown Vic doesn't engage the attention of a community repeater operator, and tower regs don't have much impact on paging amplifier design. However, if it's in the discipline, somebody may see "A" in one story and "B" in the other and thereby invent "C."

We try to keep it land mobile. We're renaming our recurring "Wireless@Work" feature series "Radio@Work" to deter submissions from people who don't read the magazine. (An editor at a sister publication recently pronounced that "wireless" now means, "wireless Internet." OK. We are old-fashioned. We thought "wireless" meant "radio.") We're into radio, but not *all* radio.

At *MRT*, I act as "gatekeeper" for submissions. That is, all roads to

the printer lead past my desk. If you're intrigued, click "How to get an article in *MRT*" at www.mrtmag.com. We prefer submissions from engineers and technicians in the field, but sometimes the manufacturers *do* have a good story to tell—really.

In the July "Making Waves" column, Associate Editor Kari Taylor solicited ideas for future articles. We received several useful responses, but a curious thing happened. Several were related to amateur radio. (I avoid the word "ham" because [a] experienced amateurs are more than mere hobbyists, and [b] our boss, Editorial Director Don Bishop, doesn't like to be compared to a hog's hindquarter.)

Now, it's been suggested—in some rather bizarre ways—that *MRT* "has it in" for amateurs, somehow. No, it's just not what we cover *here*. The PLMR and CMRS communities *do* owe a debt to the amateur ranks, though. A reader poll revealed that at least 11% of our subscribers entered commercial, private or public safety radio through the amateur radio door.

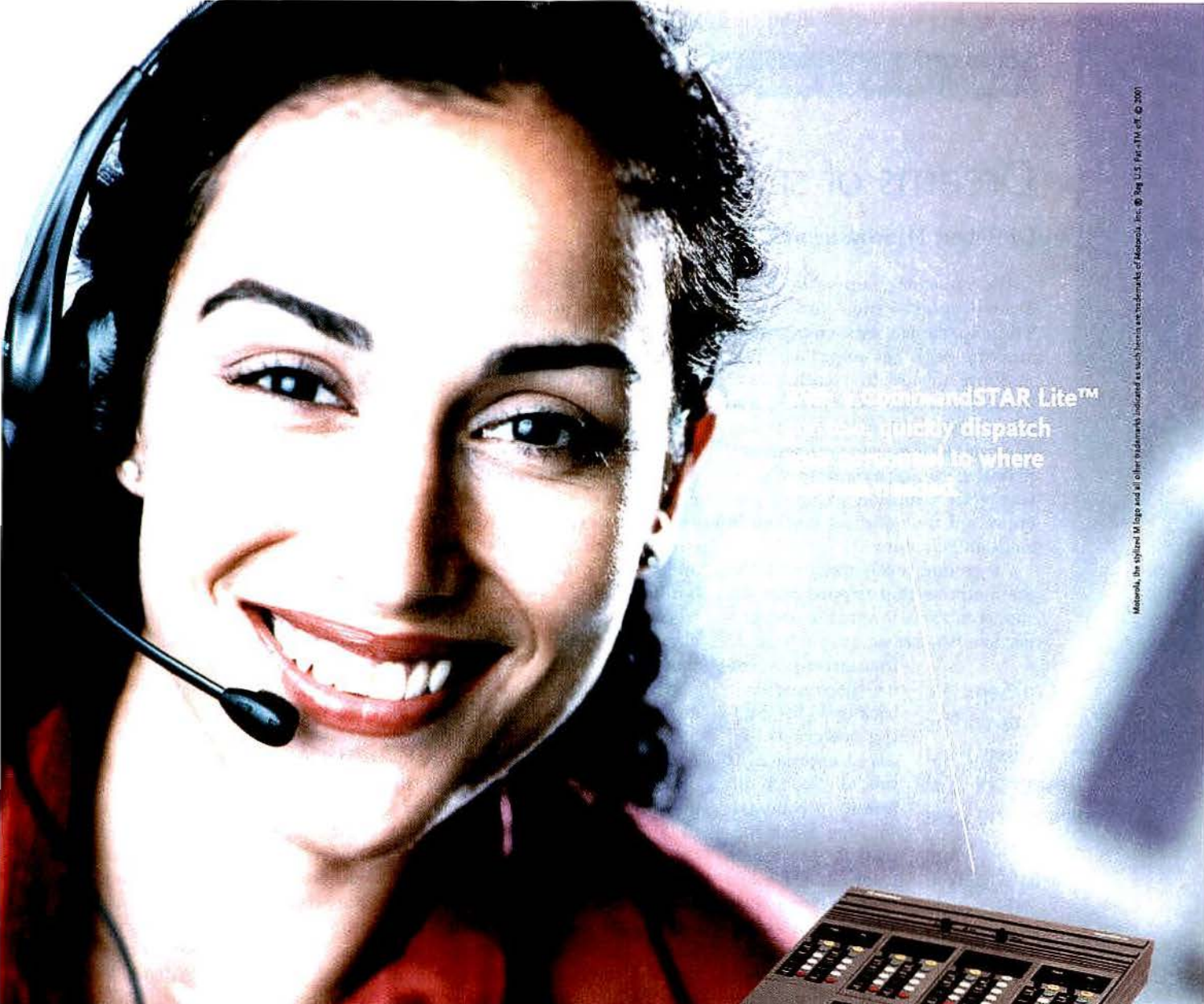
Many of *MRT's* regular contributors "DX" frequently (Don Bishop, Harold Kinley and Pat Buller, among others). There is a rooting interest in operator certifications, FCC enforcement and the respect local communities owe to amateur radio *all* the time—not just when there's a disaster. (See "Roger That," page 64.)

How do you give back? An example is in the "Point-of-Sale Perspective" column on page 47. It's one way commercial users can find a tax deduction and at the same time help the hams. (Sorry, Don.)

David A. Keckler

David A. Keckler
Technical Editor

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CIRCLE (10) ON FAST FACT CARD

Dreams of spring

By Robert H. Schwaninger Jr.

Did you ever go up in the World Trade Center? I did—last spring. The experience was memorable, starting with the approach from midtown toward the south side of Manhattan. The skyscrapers rose ever higher, as if each were trying to outdo the others in grandeur and prestige, issuing a cocky proclamation with a million yards of concrete and tons of steel stacked in rows and clusters.

At ground level, staring up the main streets that tripped past the tunnel entrance toward the port, proportions wobbled as my eyes bounced

On Sept. 11, terrorists destroyed that roof and replaced the awe of that vista with the awe that only stark devastation can produce.

from street-level coffee shops and delis back up to the glinting towers that I dared approach. It was too far, too different in comparison, too much contrast for the senses to take in, so I looked back to street level and focused ahead, as if the sidewalks were balance beams.

My steps more deliberate than I wanted to reveal, I plowed forward through the crowds, heading closer to the mark. The one big building (even though I knew there were two, I couldn't make out the other just yet) seemed to rocket above the others. Another lower, shyer brick building of only 30 stories blocked my view.

After more walking that seemed to take longer than my senses could justify, I approached the glittering edifices. The angle changed, and now I could see them both, causing an irresistible temptation to look

up and up, until my neck ached trying to catch a glimpse of the tops. Then I caught myself looking like a tourist and wondered if my awe was apparent and unseemly to the sophisticated locals.

Finally reaching the interior, I felt the power of 1 WTC. The building seemed to buzz and burst with money, influence, importance and serious business. The inhabitants each carried identification cards and observed security to get to the banks of silver elevators. If you were going up, you had better have a reason. I had one. I was getting a tour—of the roof.

Accompanied by the electrical supervisor and a contingent of people who were to review the roof and the status of the facilities operating on it, I boarded one of the elevators to begin the long ascent up the central shaft. We had to change cars to complete the journey past the lower 100 floors, and still the roof was not reached.

Through a series of locked doors and stairwells, we eventually reached the apex and stepped out onto the highest roof in the country. The view was, to me, frightening. I get vertigo. Still, I was drawn to find a spot where I felt secure and to gaze out to the distant horizon. It was a clear day. It was amazing.

Telecommunications “professionals” all, we attempted to speak about the cabling, the need for better organization of systems and operations, a revised infrastructure to deliver higher and more efficient capacity, and the status of the work that was underway to rebuild and to improve the broadcast facilities. Again and again, the conversation was sidetracked by the view. The sheer expanse of land and river and air and space just slammed into our eyes every time we focused beyond the scant confines of that one-acre roof.

One of our party revealed that he had been up on the roof dozens

of times before. Another was involved in the work to improve the broadcast tower. The tower shot up through an array of antennas and dishes that might have sprung from the fertile mind of a science-fiction writer. A third man had flown jets with the U.S. Navy for years and had seen the world from up high countless times. Nevertheless, no one was immune to the awe that standing on that roof produced.

The meeting on the roof took about 90 minutes. It only required about 20, but each of us would stop in mid-sentence and just look over the edge of 1 WTC, sometimes making a comment and sometimes just taking in the view.

On Sept. 11, terrorists destroyed that roof and replaced the awe of that vista with the awe that only stark devastation can produce. The towers were brought down, and most of the people that I saw riding elevators and laboring in dark, undecorated rooms housing hundreds of transmitters and receivers are likely lost—dead. I can't comprehend it.

Again, my perspective is playing tricks on me. I'm here in my fifth-floor Washington office situated three blocks from the White House. I pass the Pentagon every morning on my way to and from work. I see the charred and broken building and read the obituaries in the paper, reminded that another telecommunications attorney was on the flight that was forced down into that national landmark.

I am sad. I am angry. I am committed to help and to seek justice. I am grateful for my family and for my ability to walk the ground and to continue this love affair I am having with life. Still—for 90 minutes—I stood atop Tower Number 1 and dreamed I could fly. The dream has become a vivid nightmare. Damn them. I want my dream back. ■

Schwaninger, MRT's regulatory consultant, is the principal in the law firm of Schwaninger & Associates, Washington, which is counsel to Small Business in Telecommunications. Schwaninger is also a member of the Radio Club of America. His email address is rschwaninger@sa-lawyers.net.

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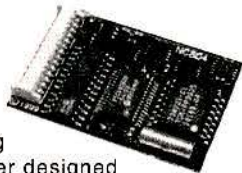
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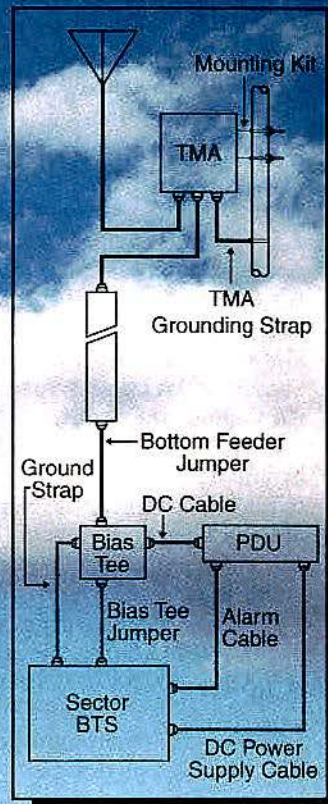
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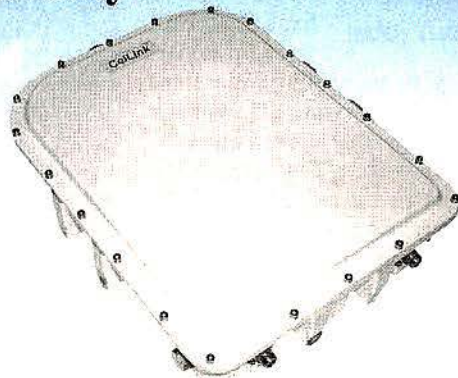
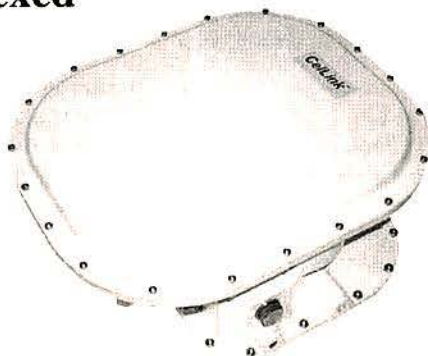
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CIRCLE 12 ON FAST FACT CARD



Good advice for the Thanksgiving holiday

Sometimes the best therapy is just doing the job.

By David O. Dunford

Our lives were changed on 9-11, a date whose numbers form a cruel irony for public safety communicators. This universal number for "help" had come to represent assistance and assurance—and a sense of security for people throughout the country.

As soon as details of the events on Sept. 11 began unfolding, I thought of the words of John Foster. He was an innovative police chief in our small town for 20 years and,

like most members of the public safety community, thoroughly enjoyed the job and the people associated with it. Nothing made him beam more broadly than the opportunity to talk about his first

love: police work. One of his favorite and most repeated maxims was "Take care of the little things. The big things will take care of themselves."

Most of the radio techs in our department are young. Like everyone else in the country, they were and remain unsettled by that day's events. Like many other jurisdictions, we opened our Emergency Operations Center. Initially, the EOC was only a clearinghouse for information. It was also the only act of preparedness we could offer against any

potential local incidents. Part of the routine setup for EOC operations is the initiation of phone service for that facility. To keep minds clear and focused and "idle hands" busy, we made a one-man job into a three-person project.

reliability of a steady paycheck with benefits and security for their family. Nevertheless, almost everyone does it to help, or to take care of other people who are in real need. My experience with communications professionals, including management, operations and technical staff, reveals this same dedication, concern and willingness to give of themselves.

For such people, there is nothing as frustrating or saddening as viewing that September day's events in the context of their own jobs. First, for the vast majority of us who were not within the affected areas, there was no direct action we could take to affect or mitigate these tragic mass-casualty incidents. Second, as facts unfolded, we began to realize that the personal liberty and sense of trust we have freely enjoyed and hold dear as the foundations of our country were the precise means by which these acts occurred.

So what's Radioman to do? Simple: "Take care of the little things." All we can do is what we have been trained and rehearsed to do: conscientiously shepherd the planning, procurement, installation and maintenance of

communications systems and equipment to be used by public safety workers in our respective jurisdictions. The work itself is remarkably unchanged, but Radioman's commitment and purpose cannot be overstated and must not be underestimated.

Maybe the maxim should be: "Continue taking care of the little things" because that's what Radioman and the whole staff have been doing all along. ■

For such people, there is nothing as frustrating or saddening as viewing that September day's events in the context of their own jobs.



Sept. 13, 2001—New York City Police Department officers enter their temporary headquarters near the World Trade Center. Photo by Andrea Booher/FEMA News Photo.

After all, it was at least a way to help us feel like we were doing *something*. Luckily, the extent of trouble in our county was the price gouging of customers by four gas stations that were playing on the public's fears. Therefore, the EOC was quietly closed down the next day.

Public safety attracts people to its workforce for a variety of reasons. For some, it's the excitement and the action. For others it's the

Dunford, MRT's public safety consultant, is technical services consultant for the Lenexa, KS, Police Department. He is a member of the Association of Public-Safety Communications Officials—International. You can email Dunford at mrt@primediabusiness.com.



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CIRCLE 13 ON FAST FACT CARD

Chicago blazes affordable path to radio interoperability

Federal resources are helping Chicago, Orlando and other cities work out their interoperability designs using the latest in interconnection technology.

By James Careless

Radio network interoperability: It's not just a convenience; it's a matter of life and death. If police, fire and EMS crews cannot talk to each other, the margin for error—and loss of life—can be profound.

Chicago's municipal government knows this well. In the two-mile-square downtown area known as the "Loop," "Thirty to 35 public safety agencies operate on a daily

to other cities across the country," he said. "We have multiple agencies using all kinds of radio equipment, spread across various parts of the spectrum."

The sheer size of Chicago and its outlying agencies also means that as many as 800 separate systems somehow have to be brought together. "These include both encrypted and non-encrypted radio systems," said Nowakowski.

"We're talking conventional analog, digital and trunked."

Given this chaos, Nowakowski could be forgiven for throwing up his hands and taking off for the nearest desert island. However, that's not his plan, nor is it Chicago's. Instead, they intend to resolve the interoperability challenge in an effective, yet affordable manner. "Affordable," in that

project. To advance their goals, the city and state turned to resources from the U.S. Department of Justice's Advanced Generation of Interoperability for Law Enforcement program. AGILE is a \$4-million program that promotes interoperability among all levels of government. Using AGILE funds, the city purchased six TRP-1000 transportable interconnect systems from Raleigh, NC-based JPS Communications.

The heart of the TRP-1000 is the ACU-1000 intelligent interconnect unit. Built into a 19" rack-mounted case, the ACU-1000 serves as a telephone-style switch for public safety networks.

"Each one is a ten-radio suite with two telephone connections," Nowakowski explained. "It allows us to interconnect radios of different frequencies and bands, along with mobile telephones, together." These disparate radios include 800MHz trunking, VHF/UHF AM, lowband and highband VHF, 900MHz and conventional cellular phones.

The ACU-1000 is essentially a junction box for all these different inputs from radios that are packed into separate, transportable cases. Together, these radios can cover it all. Add the PC that controls the system, and you've got interconnection. (The TRP-1000 also comes with antennas, power supplies and everything else needed to create a "communications switch" in the field.)

This unit takes the incoming



This Ford ambulance has been recommissioned as a mobility interoperability center.

basis," said Rich Nowakowski, but adding, "None of them can talk to each other."

A retired police officer, Nowakowski is Chicago's project manager for radio interoperability. His mission is to get public safety networks interconnected and talking with one another. That's no mean feat. For one thing, "The current radio situation in Chicago is similar

it doesn't require public safety agencies to junk their existing equipment or to spend millions of dollars to move to one standard.

A switch in time

Chicago's Department of Emergency Communications has joined Illinois' Office of State and Local Disaster Preparedness Services to launch a pilot radio interoperability

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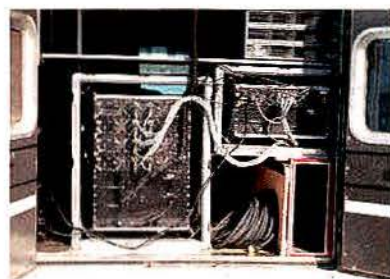
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signal and converts it into receive/transmit audio. This audio is then recorded on the PC's hard drive. The outgoing radio is selected and commanded, and the signal is sent out.

To allow ease of operation, the ACU-1000's software supplies the

necessary accessory-port control signals for each attached transceiver, making interoperability straightforward. The system uses voice prompts to set up connections (which can also be done using standard DTMF tones). This means that users can switch between radios



The transportable interconnect system fits neatly into the back of the ambulance.

remotely, without direct help from an operator.

Making the system 'ambulatory'

Chicago's first goal is to get a TRP-1000 in the field for tests. To do this, "We've taken an old 1992 Ford ambulance and converted the back into a mobile communications office," said Nowakowski. "Meanwhile, on the roof, we've installed 18 different antennas; all carefully spaced apart to minimize intermodulation and interference. The thing looks vaguely like a porcupine."

When this rig is ready to roll, the city intends to deploy it within a 75-mile radius. This will mean that Chicago proper and the six counties that surround it—Cook, Dupage, Lake, Kane, McHenry and Will—will have access to a rolling radio interconnection center.

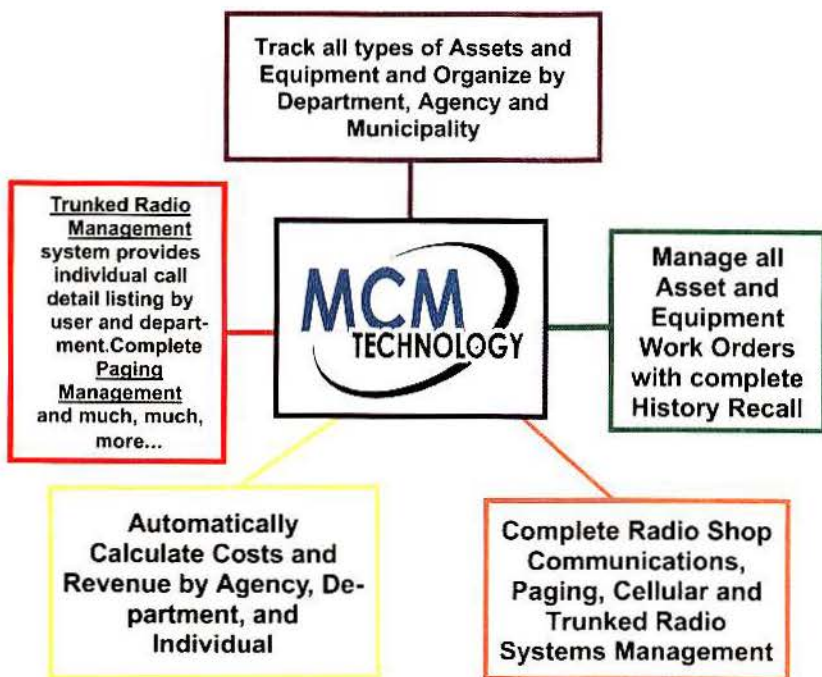
The next step will be to install one or two TRP-1000s at the Chicago Emergency Communications Center. The CECC, which opened in 1995, is a five-story, 161,000-square-foot complex that serves Chicago Police, Fire and EMS dispatch. (See *MRT Public Safety Supplement*, August 1995, "Chicago's New 9-1-1 System.") As the site of 1,000 miles of telecom cables, including one of the world's largest privately owned fiber-optic networks, the CECC is a logical location for a radio-interconnect switch.

The third step Nowakowski hopes to see is the city's purchase of a new vehicle. It won't just supplement the first mobile unit. Instead, this rig—which will carry two TRP-1000s and boast a 52' extendable antenna mast—will serve

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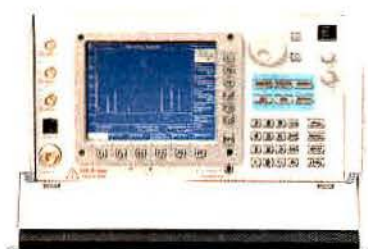
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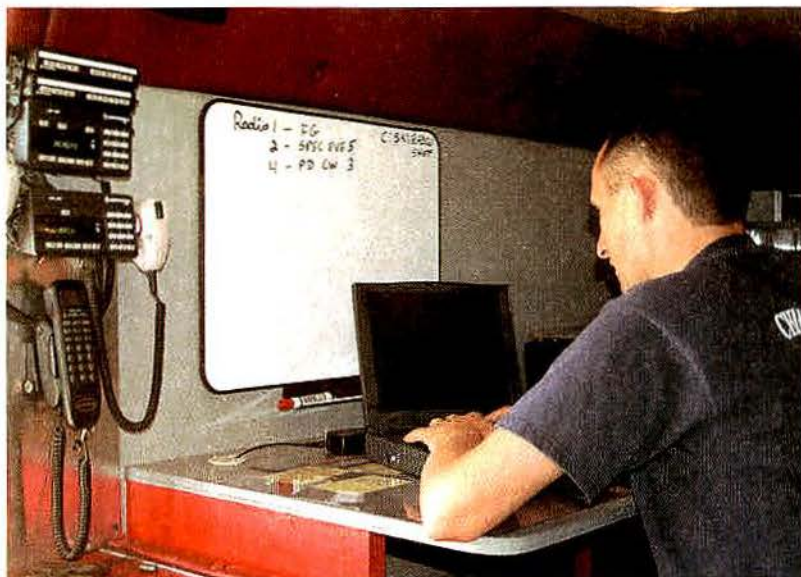
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The interconnection system allows one operator to make field systems interoperable.

as an onsite dispatch center. The mast will allow the unit to connect to the CECC through a relay station atop the Sears Tower, the tallest structure in the city. The result:

Coordinated dispatching can be managed from the emergency scene, where public safety officials can see firsthand what's needed.

But that's not all. The reason the

new truck will carry two TRP-1000s is to leave one in the field when necessary. For example, say a tornado wipes out Cook County's public safety infrastructure. No problem: Chicago takes a TRP-1000 to the scene, sets it up, and—presto—not only are public safety workers connected again, but now police, fire and EMS can talk to each other as well.

"In such cases, we'll be able to provide stricken areas with radio communications until their own systems are repaired," Nowakowski said. "All we have to do is leave a technician to show how to operate the TRP-1000 and to keep it running."

Marching to interoperability

Chicago isn't the only U.S. city to be testing TRP-1000 in interoperability trials. In fact, the \$4 million provided by Congress is also funding trials in Washington, New York, the New Hampshire-Vermont Joint Interstate Project;

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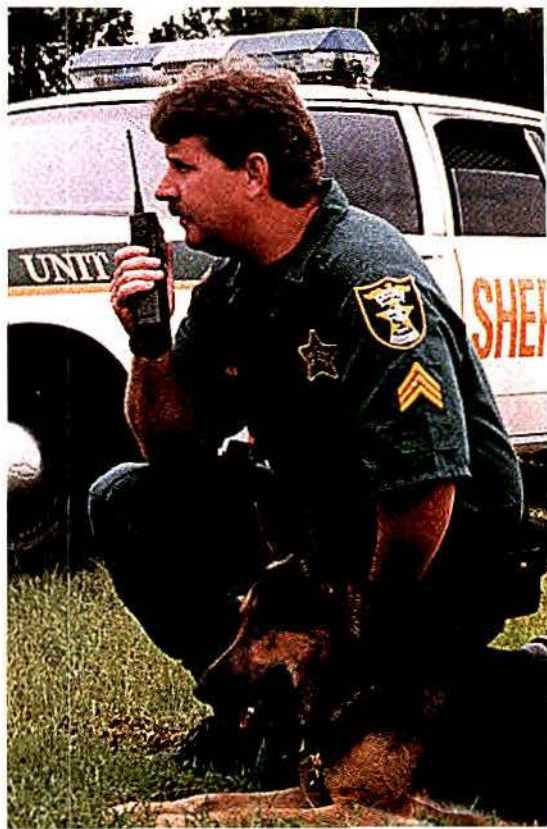
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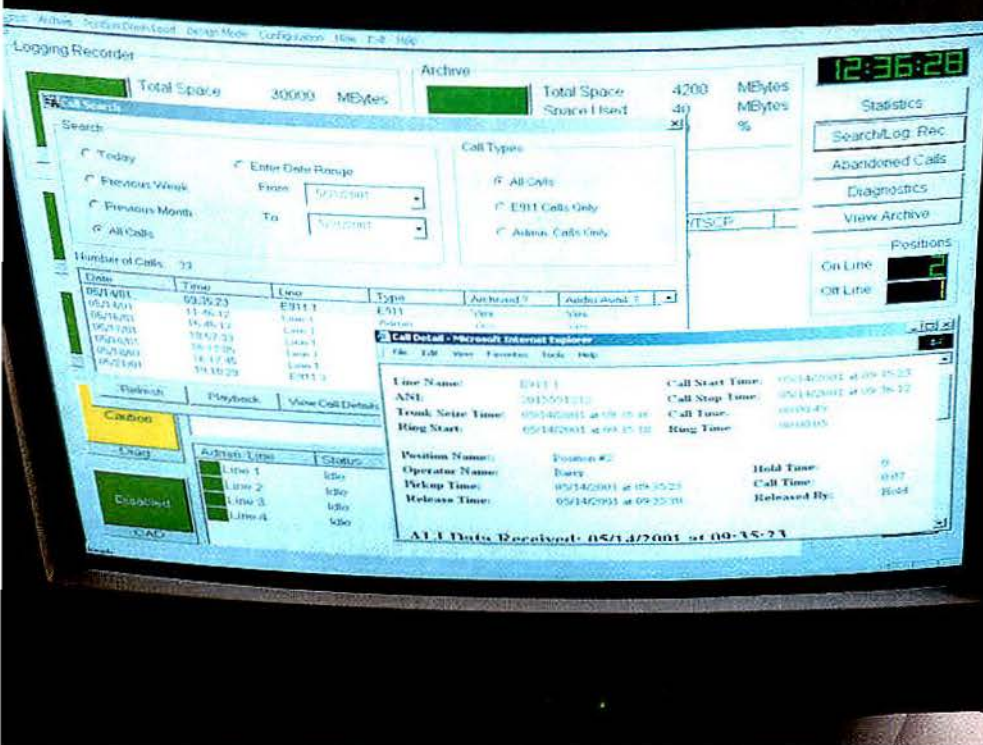


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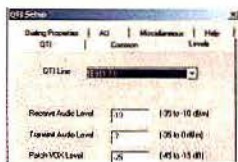


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Executive Director Gregory B. Bishop

1941-2001

One of the key individuals on the team that developed and managed the Chicago Office of Emergency Communications was Gregory B. Bishop. He was the 9-1-1 center's executive director when he died on May 19, 2001, at age 59.

"Greg was a mild-mannered man with great management skills," said Rich Nowakowski, the city's project manager for radio interoperability. "He was able to work with all of the city department heads, the vendors and with the legislature in passing 9-1-1 legislation."

Nowakowski had been Bishop's friend since 1967, when Bishop started his work for the city as a switchboard operator in what was then the Main Fire Alarm Office. Bishop's interest in radio communications dates to early childhood when he built an AM radio to monitor police calls.

Bishop rose through the ranks as junior fire alarm operator in 1971, assistant

project director for the 9-1-1 Project Team in 1987, managing deputy director of the newly formed Office of Emergency Communications in 1992 and its acting executive director in 1999 and executive director in 2000.

"Greg was instrumental in getting radio interoperability for the city off the ground. His interest in radio communications and interoperability has placed Chicago in the forefront. Through his lead, we were able to get the ACU-1000 modular interconnect system with a National Institute of Justice grant and install it in a vehicle in the first mobile application," Nowakowski said.

He also credited Bishop with the city's participation in a newly awarded \$400,000 grant for another radio interoperability project using software-defined radio equipment from the Naval Research Laboratory.

"We will be able to demonstrate newest technology in SDR by using the Joint Combat Information Terminal, including real-time video, interoperability among data

systems and a self-contained cellular network. We will be able to have our own cellular communications network if we lose infrastructure," Nowakowski said.

Bishop was known for giving special attention to the more than 500 foreign visitors who came each year to tour the Chicago 9-1-1 center, which answers 12,000 calls for service each day at 108 consoles.

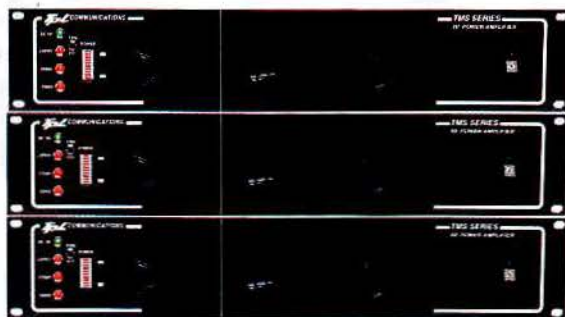
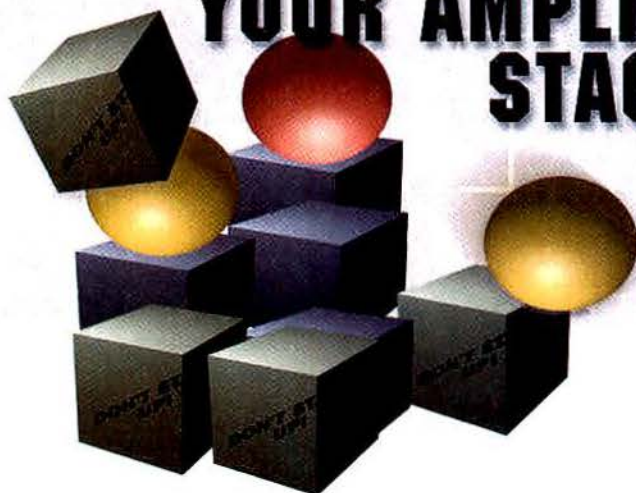
Bishop was a member of APCO and NENA; an executive board member of PSWN and Illinois LEADS; and chairman of the Region 54 Regional Conformance Review Committee.

"He was a kind and gentle man," Nowakowski said. "He was like a brother."



—Don Bishop

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CIRCLE (20) ON FAST FACT CARD

Salt Lake City; Orlando; Las Vegas; College Station, TX; Los Angeles; and Anniston, AL.

At present, some cities are further ahead in their tests. For instance, Orlando staged a mock tornado at Universal Studios on Jan. 13, 2001, to test the system. Specifically, the Orlando Community Emergency Response Team, Orlando Fire Department and a team from National Disaster Medical Systems treated 150 teenaged volunteer "victims" at Universal Studios in Orlando.

In this five-hour drill, a TRP-1000 was deployed in about 15 minutes, using some ice machines and the carrying vehicle as a ground plane. According to OFD Engineer Bret D. Barker, "What we accomplished during the exercise was an initial test of the TRP-1000 by interfacing the UHF simplex communications of DMAT 6 to the

Orange County/Orlando 800MHz Smartzone System," he said. "The radios we used were the Bendix-King EMV and EMH mobiles installed in the TRP-1000 as shipped from JPS, Motorola MCS2000 800MHz mobile radios that I have retrofitted into the TRP-1000 chassis, and Motorola MTS2000 portable radios for which I have built interface cables.

"The way I have set up our TRP-1000, it is a simple matter to initiate operations within less than a half hour of arrival, provided that there is ac power and the supplied antennas suffice," Barker said.

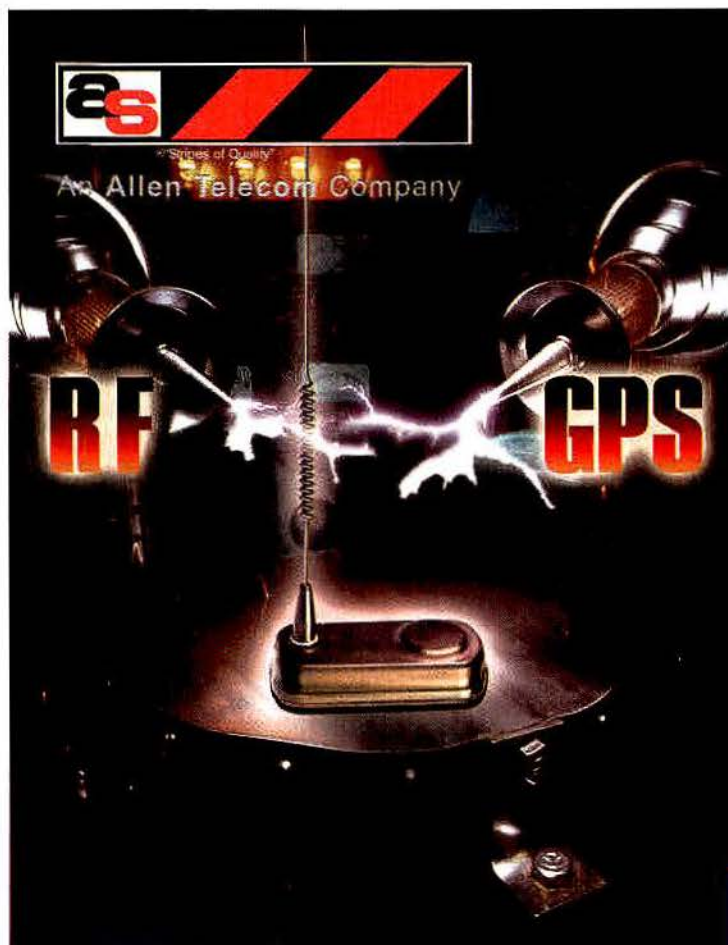
"The ability to network communications of several agencies in a field-portable piece of equipment makes operational interoperability a reality," commented Orlando Asst. Fire Chief Robert Sorenson after the mock tornado exercise. "The TRP-1000 has, in this exercise,

proven to be a reliable and useful piece of equipment."

Winding out in the Windy City

Back in Chicago, due to the unfortunate and untimely death of Emergency Communications' Executive Director Gregory Bishop (see accompanying story), projects have been slowed down in Nowakowski's department. He is hoping to deploy the TRP-1000-equipped Ford ambulance in a few weeks, but the timeline for the rest of the project—which includes setting up numerous intergovernmental and interagency committees—is still being worked out.

Still there's little doubt that interoperability is on its way for Chicago-area public safety networks—interoperability that's a lot less expensive than replacing thousands of radios. ■



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CIRCLE (22) ON FAST FACT CARD

Technical information and training material

By Harold Kinley

The "business" of land mobile radio requires those working in this field to constantly update their technical knowledge and understanding. The LMR field is diverse, continually evolving, and requires an understanding of a broader range of equipment than many other technical fields. How does one keep up? Reading *MRT* and attending the International Wireless Telecommunications Expo are two ways. Books and Internet resources are also helpful. In this column, I will recommend a few books and

Interference Problems."

The book can be ordered directly from the Professional Technical Reference Division of Prentice-Hall's Web site at: www.phptr.com or by calling 800-282-0693. The International Standard Book Number is 0-13-123159-6. The cost of the hardcover book directly from the publisher is \$70 plus shipping. It can be ordered from other major booksellers. On a sad note, Edward Singer passed away in June 2001.

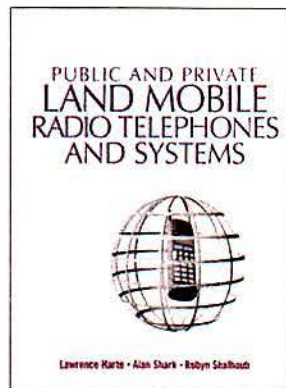
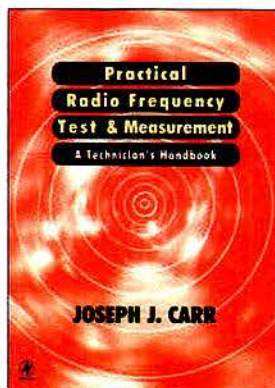
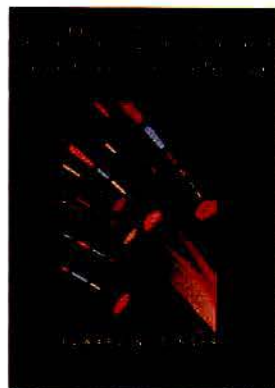
Neil Boucher's *The Trunked Radio and Enhanced PMR Radio*

and fading, amplifier classes, smart antennas and more. The book is published by John Wiley & Sons (copyright 2000). The ISBN is: 0-471-35289-6. More information on the book can be found at www.wiley.com. The book can be ordered online or by calling 800-CALL-WILEY. The cost of the hardcover book is \$99.95 from the publisher. It can also be ordered through any of the major booksellers.

Public and Private Land Mobile Radio Telephones and Systems is another useful reference for LMR technicians and others working in this field. This 246-page, 10-chapter book provides extensive coverage of the land mobile radio industry. Topics include an introduction to land mobile radio, SMR technology and evolution, analog and digital land mobile radio systems, LMR economics, future LMR technologies and advanced LMR services plus several useful appendices. This fairly recent (2000) book was written by Lawrence Harte, Alan Shark, Robyn Shalhoub and the late Tom Steiner. It is published by the Professional Technical Reference Division of Prentice-Hall. It can be ordered directly from the publisher or from any of the major booksellers. The cost of the book directly from the publisher is \$60.30 plus shipping. It can be ordered online at www.phptr.com or by calling 800-282-0693. The ISBN is 0-13-673609-2.

The late Joseph J. Carr's *Practical Radio Frequency Test & Measurement: A Technician's Handbook*

Contributing editor Kinley, *MRT's* technical consultant and a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual, with Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewyde Drive, Spartanburg, SC 29301. His email address is hkinley@home.com.

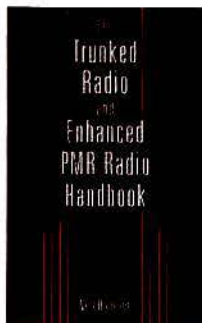


some Internet sites that are worthy of mention.

Edward Singer's *Land Mobile Radio Systems* is a *must-read* for technicians working in the LMR field. The first edition was published in 1989 by Prentice-Hall. The second edition, published by Prentice-Hall's Professional Technical Reference Division in 1994, is expanded and updated. The second edition contains 20 chapters and 288 pages of information that is highly pertinent to LMR technicians. Topics include: "Examining Conventional FM Mobile Radio Systems," "Combining Receivers and Transmitters into One Antenna," "Improving and Extending Area Coverage," "Taking Part in the Digital Revolution," "Improving Radio Shop Management," "Understanding Land Mobile Radio Propagation," and "Solving Radio

Handbook is another *must-read* for those working in the LMR field. This book contains 448 pages in 30 chapters and several useful appendices. Although it contains some math, it is written in a practical, straightforward manner.

Covered topics include: background on trunked and enhanced public mobile radio, base stations, maintenance, filters, combiners, preselectors, repeaters, linking sites, power and protection, traffic engineering on trunked radio systems, and site planning. Specific systems discussed include MPT 1327, Smartnet, LTR, TETRA, APCO-25, IDEN and other trunked systems. The book also explores equipment shelters, towers and masts, field strength, privacy, modulation, noise, coding, error correction, propagation



should be included in every communications technician's "essential" library. As the title implies, the book describes most of the RF test-

and-measurement procedures that are commonly used by land mobile radio technicians. Topics include an introduction to RF electronics and measurement theory, small components used in RF test and measurement, the Smith Chart, signal sources and generators, spectrum and network analyzers, RF power measurements, antenna gain and pattern measurements, antenna and transmission line measurements, measuring inductance and capacitance at RF frequencies and time-domain reflectometry. The soft-cover book contains 348 pages in 14 chapters. It was published by Newnes, an imprint of Butterworth-Heinemann and copyrighted 1999. The ISBN is 0-7506-7161-0. It costs \$34.95 and can be ordered online at www.newnespress.com or by calling 800-366-2665.

In addition to books, many Internet sites also contain information that is useful to those working in land mobile radio. A good online computer-based training course is available at: www.motorola-wls.com/CW_ACS002/cbt/course.htm. This site provides a good tutorial on trunking and the Motorola Astro digital radio.

Another popular land mobile radio Web site is Rune's LMR Links

at rune.tapper.com/lmr.

Many more Web sites offer good information, useful software or online calculators that can be helpful in LMR work. If you know of Web sites that might benefit your fellow *MRT* readers, pass them along to me, and I will share them

with the readers of this column. Please, the Web site must contain something educational or otherwise useful to LMR personnel—not just raw advertising.

Oh, while we're at it, don't overlook www.mrtmag.com.

Until next time—*stay tuned!* ■

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CIRCLE (23) ON FAST FACT CARD

SIGNALS FROM GROUND ZERO

On Sept. 11, 2001, firefighters, police officers, EMS workers and dispatchers not only battled dust and fire, but faced disabled communications as well. Despite the devastating damage, they continued to work to save lives.

By James Careless

U.S. public safety networks are hard to disrupt. Weeks after the attack on New York's World Trade Center, public safety communicators continue to assess how badly their networks have been damaged. The bottom line is, communications systems were battered but not beaten.

The fall of a legendary site

As tower sites go, 1 World Trade Center was one of the best in the world—certainly the best in New York City for wide-area coverage. Small wonder: with a rooftop 1,368 feet above street level, 1 WTC was the highest building on the East Coast. The nearly one acre of rooftop bristled with antennas



COMMUNICATIONS COMBATING CHAOS

Thousands of Americans cheered emergency workers as they arrived at ground zero. On *MRT's* cover this month is one of the heroes they were cheering: Sgt. Brian Boyar of the New York City Sheriff's Office Firearms and Tactics Unit.

An *MRT* public safety subscriber captured this moment in the 23-minute interval between the two collapses of the World Trade Center towers.

"When [2 WTC] collapsed, it was everyone running around. You just took care of one thing at a time, as you were going down the street. Guys were trapped everywhere," said Michael Coppola, the 10-year subscriber who contributed this photograph.

Coppola was at this scene of horror because he was reporting on a two-way radio notification system for the New Jersey/New York metropolitan area called Metro Fire Radio.

Metro Fire Radio keeps members of public safety agencies and the press informed of ongoing emergencies. Individuals may also keep in touch with one another over the system. The system uses UHF radios (452.175MHz) to communicate across several repeater systems throughout the metropolitan area. When a member hears of an incident, he retransmits the information over the radio system. Metro Fire Radio is "an off-duty type of club" that provides a benefit to public safety members, according to Coppola.

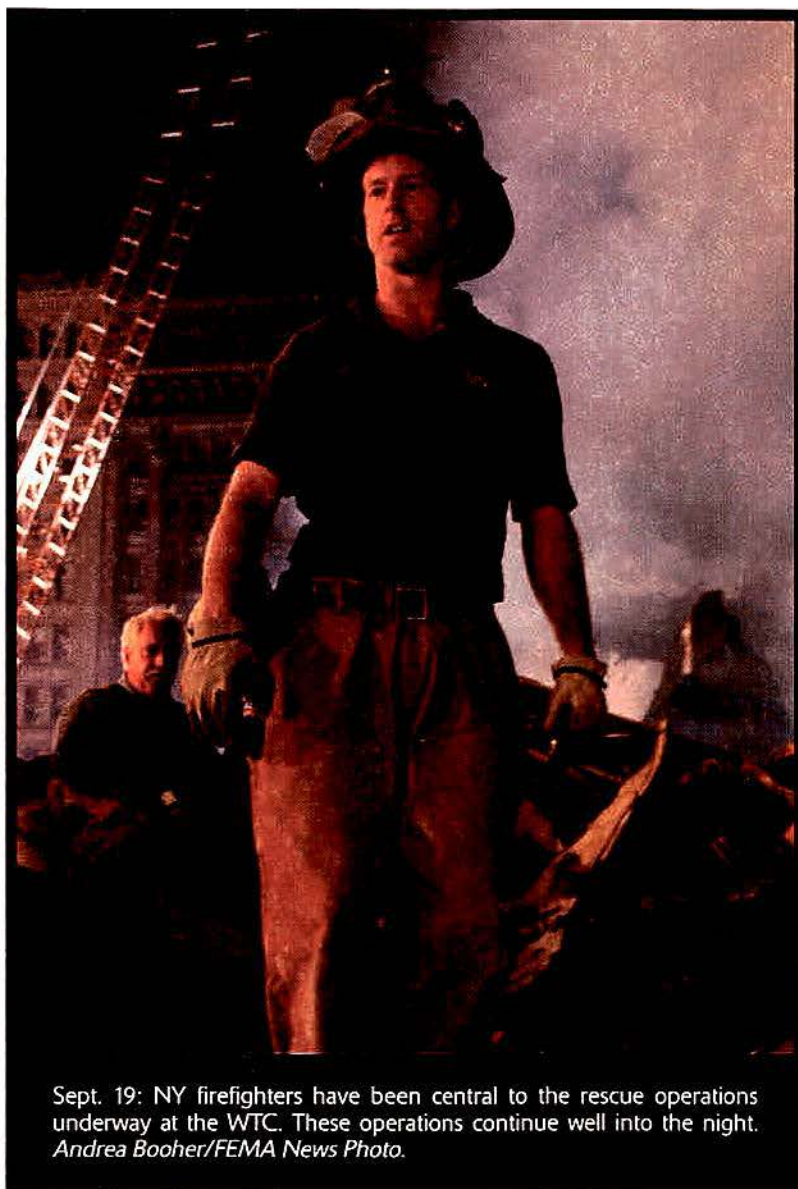
"Since it has been established, Metro Fire Radio has grown to a membership of over 120 members," Coppola said. "Most agencies in our area that have UHF radios dedicate a channel for our organization." Members also take photos of the incidents and coordinate with arson squads, emergency agencies and the press afterward.

Coppola also was there because he wears all three public safety hats: He is a police officer, a firefighter and an EMT. As an officer with the Palisades Interstate Parkway Police in

Continued on page 30



Facing page: Sept 26: Members of the Colorado Task Force One and California Task Force Three stand amid the debris of the WTC in lower Manhattan. Mike Rieger/FEMA News Photo. Above: Photo by Michael Coppola, Metro Fire Radio.



Sept. 19: NY firefighters have been central to the rescue operations underway at the WTC. These operations continue well into the night. *Andrea Booher/FEMA News Photo.*

DEDICATION

At press time, it is just four weeks since the simultaneous terrorist attacks on New York and Washington and the attack that was thwarted in the skies of Pennsylvania by selfless common citizens.

It is still impossible to comprehensively report on the human cost of these atrocities—these wholesale mass murders. *MRT's* editors decided to focus on the repercussions in the telecommunications community and on public safety communications effects in particular.

We have combined our story by freelance telecommunications writer James Careless with contributions from the *MRT* staff to create this overview.

The communications complications of an urban disaster led us to concentrate most of this report on the World Trade Center attack. This is not intended to diminish the tragedies in Pennsylvania and Washington.

Sept. 11 was National 9-1-1 Day, and hundreds of public servants gave what Abraham Lincoln called "the last full measure of devotion." Many valiant police, fire and emergency medical teams' signals from ground zero went silent on Sept. 11. This report is dedicated to them and to the PSAP operators and dispatchers who supported them.

—The Editors

spaced at about every five feet.

"It offered the most efficient coverage for public safety, or indeed any kind of RF transmission," said John Paleski, president of Old Bridge, NJ-based Subcarrier Communications. Subcarrier, a communications site management company, lost numerous antennas when 1 WTC collapsed.

Pinnacle Towers' Joe Furmanek, director of investor relations, echoed Paleski's assessment. Based in Sarasota County, FL, Pinnacle had the management contract for 42 non-broadcast antennas on

Continued from page 28

New Jersey, Coppola helps the Phoenix Team, a crisis-intervention unit, among many other public safety ventures.

On Sept. 11, he and two other Metro Fire Radio members, Dave LaGruth and Matt Schneiderman, arrived about eight blocks away from the WTC, in front of the NYPD 1st Precinct. They began taking photos—"Our original reason for going to this job," Coppola said. But when 2 WTC collapsed, and they reached the initial-response staging area, they had no time to take pictures. "We immediately began washing off firefighters who couldn't breathe because they were covered in debris and ash. After we 'rehabbed' the brothers in the area, we started putting out numerous debris fires with fire extinguishers," Coppola said.

The group soon had to take cover again as the north tower collapsed. Once the situation stabilized, they "got right back to putting out even more fires and dodging exploding car fires—photographing what we could when we could," Coppola said.

In this way, Metro Fire Radio played its part in this disaster that motivated many Americans to help, whether in giving blood, contributing money or praying.

"Looking back on the TV stations when we got home, it was like watching the whole thing in 'mute' without the screams and sound of 110 stories crashing to the ground," Coppola said.

—N. Chandler

1 WTC's rooftop.

"We covered public safety networks, paging firms, cab companies—the works," Furmanek said. Federal government agencies were affected as well. Furmanek wasn't at liberty to identify them beyond saying, "Just think of all the highest-level ones in the country. They were all there."

Height alone didn't make 1 WTC's rooftop ideal for transmission; it was also the layout.

"With the exception of the broadcast tower, you had a very flat,

uncluttered roof to work with," explained Pinnacle President Ben Gaboury. This made it possible to mount the antennas "in almost a geometric pattern," he added, with the cables traveling neatly through hatchways "into the multiple equipment rooms one floor below."

For Richard Tell, losing the WTC sites was like losing a personal friend. Tell, the president of Las Vegas-based Richard Tell Associates, had been the key RF safety consultant to the Port Authority of New York and New Jersey,

AN INDUSTRY RESPONDS

The events of Sept. 11 affected several trade associations and land mobile radio manufacturers, whether it was in cancellations or in their rush to aid the rescue and recovery workers:

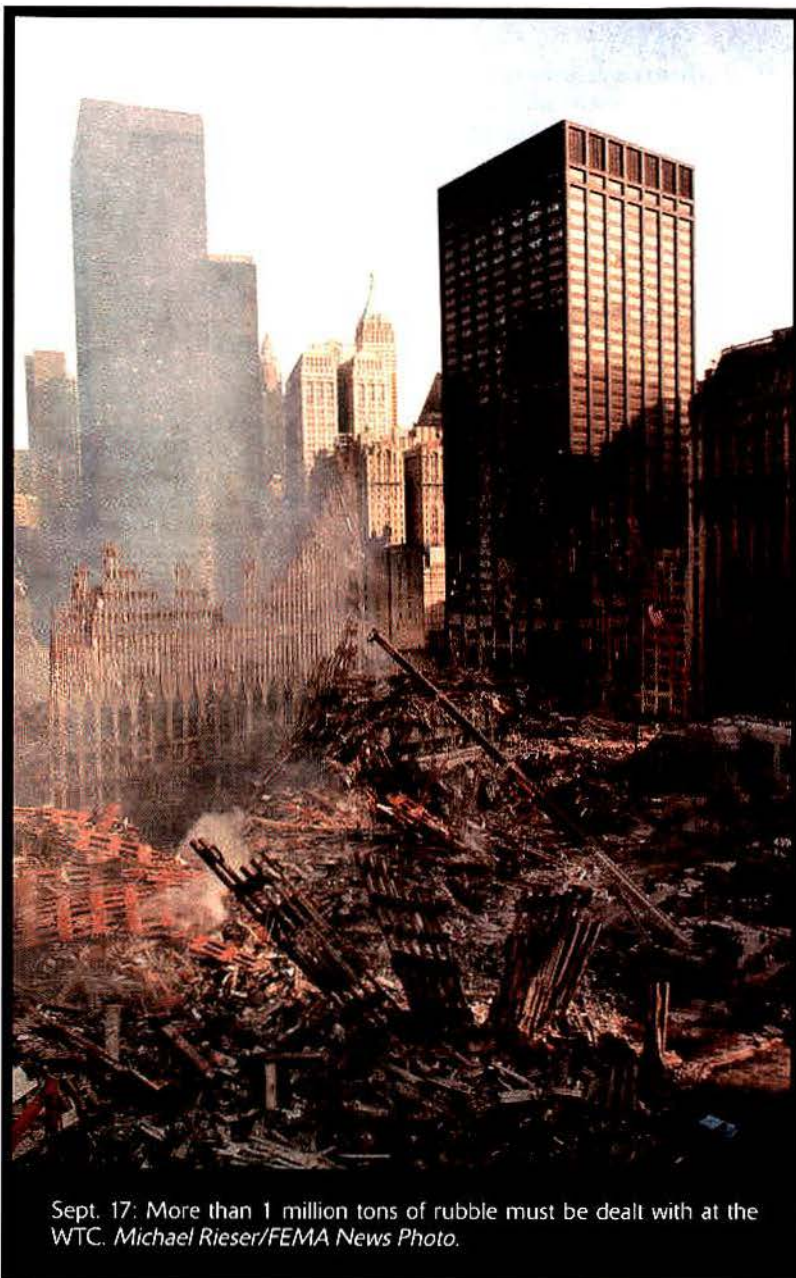
AeroComm, Englewood Cliffs, NJ, helped cellular telephone companies and the Port Authority reestablish telephone and radio coverage at ground zero using infrared transceivers and reconfiguring existing cellular telephone infrastructure in New Jersey. Aerocomm personnel are also working with the Port Authority to restore its emergency public safety radio systems.

Nextel Communications, Reston, VA, began lending wireless telephones that day to federal, state and government agencies and to emergency service providers, such as the American Red Cross. More than 2,000 phones with unlimited cellphone and two-way radio service were delivered to New York, Washington and Boston.

Itronix donated 20 of its portable computers to the relief effort in New York. The computers can display three-dimensional models of debris in the area of the collapse. These renderings will assist in removal of the wreckage, as well as pinpoint the location of hazardous substances known to be in the buildings at the time of the collapse.

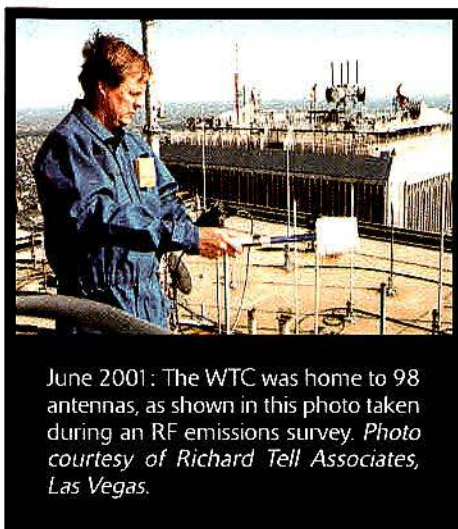
The **Industrial Telecommunications Association** canceled its 2001 Private Wireless Spectrum Management Conference and Exposition after what ITA President Laura Smith said was "careful consideration of all the relevant issues, as well as consultation with the leadership of ITA, USMSS and CICS." On Sept. 12, ITA had postponed the conference, which was originally to be held Sept. 19–21 at the Grand Hyatt in Washington.

The **Personal Communications Industry Association's** GlobalXChange scheduled for Sept. 11 in Los Angeles was canceled. Two industry figures—COO of Metrocall Steven Jacoby and Karen Kincaid, a partner in a Washington law firm—died on American Airlines Flight 77. —K. Taylor



Sept. 17: More than 1 million tons of rubble must be dealt with at the WTC. Michael Rieser/FEMA News Photo.

Motorola and the WTC broadcasters since 1996. Tell assisted the Port Authority in developing a comprehensive RF safety program for the buildings. The rooftops had been measured and modeled on numerous occasions to ensure that technicians and maintenance workers on the roof of 1 WTC—and visitors viewing the city from the



June 2001: The WTC was home to 98 antennas, as shown in this photo taken during an RF emissions survey. Photo courtesy of Richard Tell Associates, Las Vegas.

roof of 2 WTC—would be safe.

"It was a truly amazing transmission site," recalled Tell. Having performed RF field measurements for the broadcast mast earlier this year, he added that "to see the WTC come down along with its 351-foot antenna mast made me feel sick."

All of the city's TV stations used the antenna mast on 1 WTC. So did four commercial FM radio stations. All went off the air when the building fell. Only one, WCBS (Channel 2) had a backup facility in place at the Empire State Building.

As for non-broadcast applications, the rooftops of 1 WTC and its twin, 2 WTC, were home to a veritable forest of antennas—98 in all. These served a wide range of networks, including the Port Authority's 800MHz Ericsson EDACS trunking system, which was lost in the fire and building collapse. One of the federal government's 400MHz Motorola Smartnet trunking systems was destroyed as well, said Larry Van Horn, an editor with *Monitoring Times*, a magazine for scanner enthusiasts.

"Even the New Jersey Highway Patrol took a hit," Van Horn said, because two-thirds of New Jersey was covered by an 800MHz trunking system on the World Trade Center. Meanwhile, the New York State Police's network was disrupted, but not destroyed, when 2 WTC disintegrated. That site was home to the state police 800MHz Ericsson Metro-21 EDACS trunking transmitters and antennas. Fortunately, the NYSP has sites and towers in other parts of the city.

In the midst of all this mayhem, FDNY's communications infrastructure emerged relatively unscathed. "The fire department's central offices each have their own transmitter antennas," said a source within the department. Because none of these sites was located at the World Trade Center, "they were completely unaffected," the source said.

Of course, this only applies to the FDNY's dispatch function. Beyond the immeasurable human cost, hundreds of mobile and portable radios were lost when the Twin Towers collapsed on emergency responders from FDNY/EMS, NYPD, the Port Authority and other emergency agencies. FDNY's Field Communications Unit, which was at the World Trade Center, was also seriously damaged when 1 WTC collapsed.

Meanwhile, the city of New York's 15-channel Motorola Smartnet System network remained fully operational during the crisis. According to Steve Gorecki, public relations manager for Motorola's North America Group, it served as "a primary system used for interoperability." The city's Department of Information and Telecommunication Technology (DoITT) was in charge of running it.

Coping with the unthinkable

When the World Trade Center was lost, the New York State Police reacted quickly. The agency's response was pragmatic and practical: "We just took an antenna at another one of our sites and pointed it down into Manhattan,"

STILE: BACKUP IS CRUCIAL

Public safety communications coordination in New York is complicated enough on an average day. In the wake of the WTC attack, the process has become even thornier. Nevertheless, for Vincent Stile, those thorns surround a rose, and that rose is called cooperation.

Stile, of the Suffolk County Police Communications Bureau on Long Island, NY, is the local frequency advisor for Southern New York for the Association of Public-Safety Communications Officials—International. He is also APCO's first vice president, and according to APCO's leadership succession, he will become its president in 2003.

"We have enough backup," Stile said of the state of the post-attack infrastructure. "Our biggest need is frequencies."

New York public safety communications officials have been discussing action plans in case of a terrorist attack for more than 10 years, Stile said, and "Things have been working. These guys have been putting in 12-hour days."

National 800MHz channels have been the primary routes for interoperability in the wake of the attack, Stile said, but it has been an effort to coordinate firefighters on VHF, police on UHF-T band and city services on 800MHz. In the future, interoperability channels in UHF may be the regional focus, based on a UHF-TV channel 16 waiver.

An attempt had been ongoing within Region 8 (New Jersey, southern New York and western Connecticut) to coordinate efforts and to create an overlay plan prior to the WTC attack. In particular, an 11-agency group in the NYC area, including police, fire, EMS and DOT, has been working on interoperability and mutual aid since 1990.

"We've been working on a communications network from Montauk Point (the eastern tip of Long Island) to Bergen County (NJ)," Stile said, but progress is slow because of the different technologies used by all the agencies

Continued on page 34



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Continued from page 32

in between. There is always bureaucracy as well. "We were just building out. Government works very slow, and money is always critical," Stile said.

The response to the disaster held numerous bright spots, Stile said. The New York State Police was able to get a Special Temporary Authority from the FCC to relocate from the WTC to the Chrysler Building. With five stations in the area, that left NYSP with four sites for redundancy. The Port Authority of New York and New Jersey was able to switch its operations to its Staten Island site. The New York State Office of Emergency Management sent Stile two emergency base stations that were quickly tuned and deployed to sites in Nassau County and on Rikers Island.

Stile said he and his peers in Region 8 are preparing an overall report on how the public safety communications community responded to the events of Sept. 11 and what it requires to improve interoperability. To other agencies around the country that might be placed in an emergency communications situation before this crisis has passed, Stile had advice: "Have backup systems and redundancy. Establish alternate paths, whether you're putting a system on a tower or a building. Have an overlay plan." —D. Keckler

said State Police Dispatcher Sgt. Bob Jones. Of course, this was a makeshift measure, as was the State Police's deployment of VHF hand-helds. What was needed was a replacement for the WTC site, and the State Police soon found one at the midtown Chrysler Building. Surprisingly, this installation went extremely fast, Jones said. In fact, "We had it up and running by the evening of the 12th." Fortunately, previous tenants at the Chrysler Building site had left four antennas in place when they moved out. Better still, these tenants had also left antenna combiners behind, "so we were able to utilize the existing antennas," Jones said.

This left the need for a transmitter. The day was saved by M/A-COM, which rushed a five-channel Ericsson independent 800MHz trunking system to the site. M/A-COM also threw in 200 hand-helds for good measure.

Today, the coverage being provided by the State Police's Chrysler building site is "very good," said Jones. "We now pretty much have the whole city back."

With the NYSP back on air, the next step will be to build a more permanent replacement site. "We're looking at probably trying to stay in the Chrysler building," Jones said, "but obviously we have to do a lot of propagation studies."

Motorola also distinguished itself by sending 86 truckloads of gear to New York. These supplies included a new 15-channel Motorola 800MHz backup system for the Mayor's Office of Emergency Management, which runs on the DoITT's Smartnet System. Motorola employees worked around the clock to build the backup system, doing in 30 hours what usually takes three weeks. P & R Communications, Dayton, OH, supplied a trailer-mounted, 107-foot tower, antennas and grounding equipment. Beyond this, Motorola delivered separate trailer-mounted 800MHz and 900MHz radio systems to New York.

"We've also sent in 10,000 portable radios and 16,000 batteries," said Motorola's Gorecki.

Rebuilding with resolve, realism

Clearly, these emergency solutions (which also include the deployment of HF radios) are no substitute for the loss of the WTC platform. It's still unknown what will end up replacing the World Trade towers, with all their wonderful height. Chances are that if any structures are erected at the site in South Manhattan in the distant future, they will be no more than 50 to 60 stories tall, in line with current architectural trends and the realities of urban firefighting.

Even if a new World Trade Center should rise, phoenix-like, back up to 110 stories, would telecom

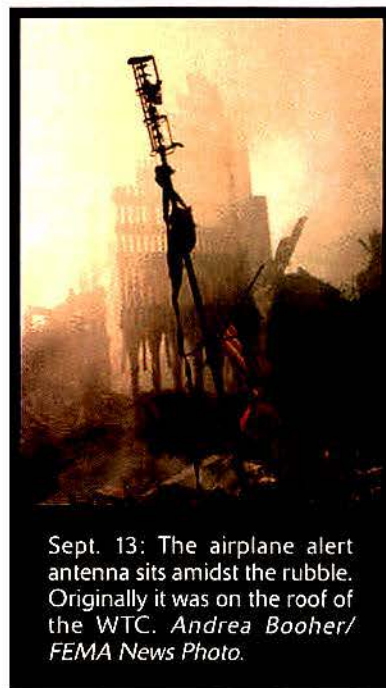
companies put all their eggs in one basket again? It's not likely, said Subcarrier's Paleski.

"We learned two lessons on Sept. 11," Paleski said. "The first is not to concentrate all of one's critical telecommunications facilities in one place. The second is to have a backup ready to go immediately, in case something unthinkable happens."

"No one learned this second point more cruelly than New York's TV broadcasters," Paleski added. "Why, WABC, WNBC, WWOR, WPIX and WNET had just finished installing their digital TV transmitters on 1 WTC, days before it was destroyed."

It will be months before we know the full extent of how badly New York's public safety networks were damaged. In fact, given the heightened emphasis on U.S. homeland security, we may never know. Were the city and state networks caught unprepared? Yes and no. Yes, in that no one expected the World Trade Center towers would be completely destroyed. No, in that backup plans were in place, and the people who manned them did their jobs, despite the catastrophe. ■

Careless is a freelance telecommunications writer based in Ottawa, ON, Canada. His email address is james@tjtdesign.com.



Sept. 13: The airplane alert antenna sits amidst the rubble. Originally it was on the roof of the WTC. *Andrea Booher/FEMA News Photo.*

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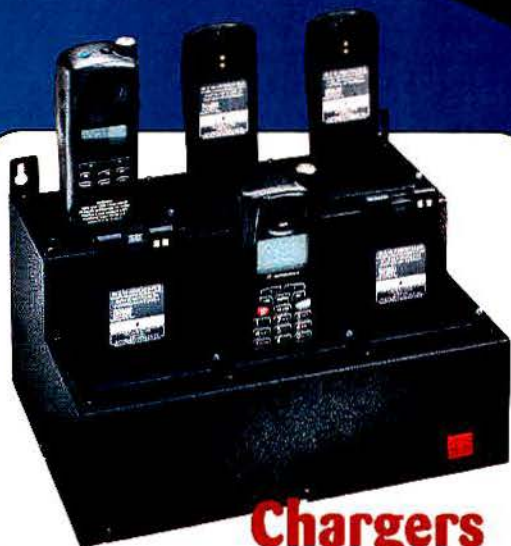
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Wideband noise measurements on TETRA transmitters

Performance requirements for TETRA mobile and fixed equipment require testing the interference levels produced by the transmitter.

By Richard Ridgewell and Tim Carey

The ETS EN 300-394-1 standard defines the radio test methods to be used in TETRA type testing. The specification includes a definition for the minimum performance, the test method to be used and the accept-

255 symbols within each burst.

The measure of average transmitter power level will be used as the 0dB reference for the wideband noise measurements.

Within the bands specified in Table 1 at the left, measurements must be made at 112.5kHz, 262.5kHz, 512.5kHz and frb + 12.5kHz.

The conformance specification for acceptable uncertainty introduced by the measurement equipment used to test wideband noise is:

RF power relative to 0dB reference (0dBc to -45dBc) = $\pm 1.0\text{dB}$

RF power relative to 0dB reference (<-45dBc to -105dBc) = $\pm 1.5\text{dB}$

for a swept measurement approach increases the dynamic range requirement (e.g., a 180Hz resolution bandwidth implies a dynamic range of 120dB). This presents a significant challenge for the log amp and detectors of any spectrum analyzer.

TETRA requires that the wideband noise measurement be performed while synchronized to the burst carrier. A normal spectrum analyzer cannot maintain synchronization with the carrier while tuned to the offset frequency. Why can't you just sweep the spectrum analyzer slowly across the measurement channels? First, swept spectrum analyzers only see one portion of the spectrum at a time and therefore might miss the occurrence of the burst. Second, a slow sweep will give a small video filter bandwidth. Video filters are applied after RF detection and log conversion. Applying a filter to a noisy power series, after log conversion, will return a measurement error.

Furthermore, any rise in noise level during the burst period will be rejected by the action of the video filter. The default video filter setting can usually be replaced by a user-specified value. If a video bandwidth much greater than resolution bandwidth is selected, then this introduces another variable—namely, many video samples for each pixel will be on the spectrum analyzer screen. Most spectrum

Table 1. ETS EN 300-394-1 requirements for wideband noise.

Frequency offset from carrier	Wideband noise minimum requirement		
	Mobile station (MS)		Base station all
	Power level $\leq 1\text{W}$	Power level $> 1\text{W}$	Classes & MS Power level > 5
>frb	-100dBc	-100dBc	-100dBc
500kHz-frb	-80dBc	-85dBc	-90dBc
250kHz-500kHz	-80dBc	-83dBc	-85dBc
100kHz-250kHz	-75dBc	-78dBc	-80dBc

Note that "frb" denotes the frequency offset corresponding to the near edge of the received band, or 5MHz (10MHz for frequencies above 520MHz), whichever is greater. All levels are expressed in dBc relative to the actual transmitted power level, and in any case, no limit greater than -55dBm for offsets <frb or -70dBm for offsets >frb shall apply.

able uncertainty level of the measurement equipment.

For wideband noise, the standard requires that the measurement be made through a TETRA filter. This is a Nyquist filter with an 18kHz bandwidth. The wideband noise-performance limit varies as a function of both transmitter power class and offset from carrier.

The measurement method specified in the standard states that the test system will calculate the average noise power over at least 20 TETRA bursts. The measurement samples must be taken synchronously with the transmitted burst. Furthermore, sample data must cover at least 200 of the

Limitations of test methods

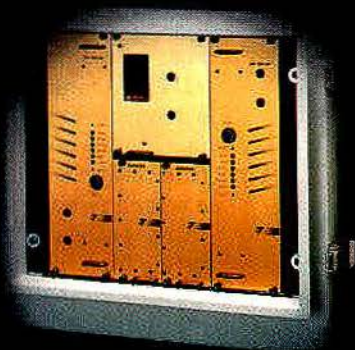
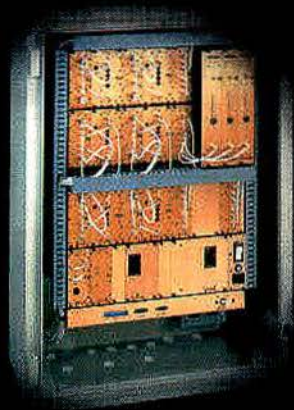
General-purpose spectrum analyzers suffer from a number of deficiencies that make them unsuitable for this measurement. Typically, spectrum analyzers do not incorporate a TETRA filter. This filter is not possible to implement accurately as an analog filter. Instead, a spectrum analyzer uses swept measurement with a narrow IF resolution bandwidth. The responses are weighted and summed to approximate an otherwise true Nyquist response.

For a measurement made using the TETRA filter, the dynamic range requirement is 100dB. Reducing the resolution bandwidth

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analyzers use a selection algorithm, which attempts to pick out the sample peaks. Again, this leads to ambiguity when trying to measure noise power.

Spectrum analyzers may provide external gating capability so that the analyzer only sweeps when the TETRA transmitter bursts. This overcomes some of the drawbacks of using a spectrum analyzer, but a gated sweep requires the addition of a second receiver to be tuned to the carrier or the supply of external triggering from the device under test.

All of these problems make general-purpose spectrum analyzers unsuitable for TETRA wideband noise measurement.

Creating specialized equipment

To address this specific testing need, IFR Systems developed a TETRA-specific signal analyzer.

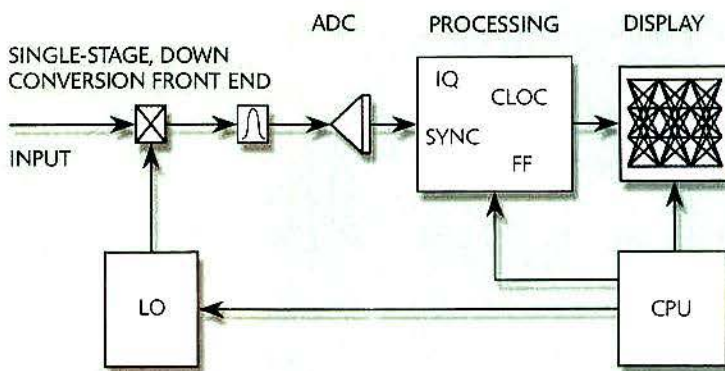


Figure 1. 2310 block diagram.

The Model 2310 (Figure 1) uses a single-stage downconverter to create an IF of 10.71MHz. The IF signal is amplified to match the operating point of the instrument's analog-to-digital converter. The analyzer uses a single-bit bandpass

delta sigma converter. This patented converter architecture was developed to obtain a dynamic range suitable to the rigorous demands of TETRA transmitter testing. Once digitized, the IF is passed to dedicated signal-processing

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Table 2. Residual noise floor of the 2310.

OFFSET FREQUENCY	2310 RESIDUAL NOISE FLOOR (18KHZ BANDWIDTH)	
	Fc < 500MHz	500MHz < Fc < 1GHz
100kHz-250kHz	-88dBc	-88dBc
250kHz-500kHz	-98dBc	-98dBc
500kHz-5MHz	-100dBc	-98dBc
> 5MHz	-105dBc	-103.5dBc

hardware that generates a filtered I/Q data stream. The I/Q data are passed to an Analog Devices SHARC DSP that runs the TETRA measurement algorithms.

TETRA wideband noise

The analyzer performs synchronization by demodulating the signal to find the training sequence. This is used to set an accurate internal-timing reference that enables the measurement software to

predict when the transmitter is bursting and to avoid the need for a second receiver or external gating input.

When configured for the majority of its TETRA measurements, the analyzer has a noise floor density of -128dBc/Hz, equal to -85dBc in a TETRA filter.

To extend the dynamic range to more than 100dBc, as required for wideband noise measurement, the analyzer incorporates a switched-IF

bandpass filter. The filter is used to pass the noise channel and to reject the carrier. This allows the IF sensitivity to be increased without fear of saturation by the carrier.

For carrier offsets greater than 250kHz, the dominant factor becomes the noise floor of the local oscillator. Reciprocal mixing between the local oscillator and the incoming TETRA carrier ensures that the IF noise floor does not fall below the local oscillator noise floor. However, the local oscillator noise floor is more than -105dBc when measured through a TETRA filter and therefore exceeds the transmitter specification.

Table 2 above shows the variation in instrument sensitivity against offset from carrier. The analyzer's residual noise is below that of the TETRA specification for all offsets.



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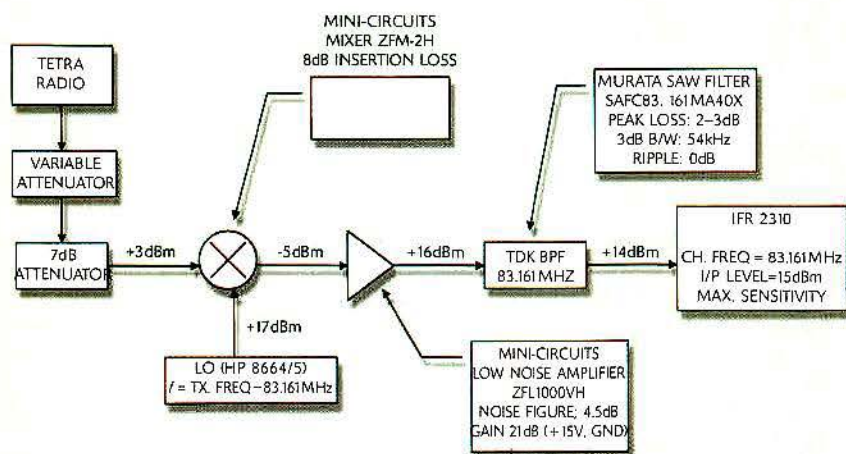


Figure 2. Setup for enhanced wideband noise measurement.

Enhanced wideband noise

The analyzer's option 01 is designed to increase the maximum measurement range from -105dBc

to -110dBc and thereby to provide a 10dB measurement standoff against the ETSI requirement.

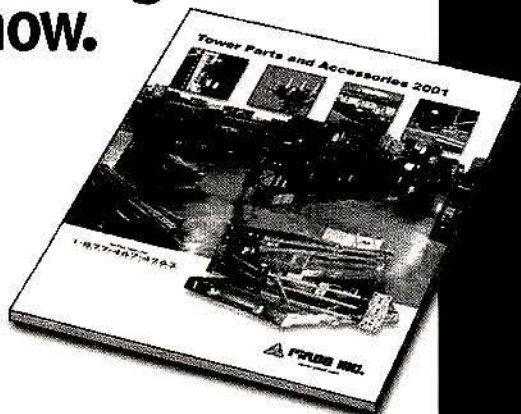
The analyzer provides no image

rejection. The IF frequency is 10.71MHz, giving an image response 21.42MHz away from the desired input signal. If the transmitter under test has a flat noise floor extending beyond 26.42MHz (5MHz plus image frequency) from the carrier, then the noise floor will be raised by 3dB. Option 01 removes image noise from contributing to the measurement.

Wideband noise measurement

The function of the external components is to produce an IF in the range of 80MHz to 200MHz that is then fed to the analyzer as the RF input. In this way, sufficient selectivity is obtained to prevent device-under-test image noise from compromising the measurement (i.e., with an externally generated IF of 80MHz, the image product seen by the analyzer is 160MHz away). The noise profile of a TETRA transmitter will diminish sufficiently at

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Table 3. Residual noise floor of the 2310 with external down converter.

OFFSET FREQUENCY	MEASUREMENT SYSTEM RESIDUAL NOISE FLOOR (18kHz BANDWIDTH)	
	2310 + EXTERNAL COMPONENTS	ETSI
100kHz-250kHz	-90dBc	-80dBc
250kHz-500kHz	-100dBc	-85dBc
500kHz-5MHz	-100dBc	-90dBc
> 5MHz	-110dBc	-100dBc

that offset, and consequently will not raise the noise floor seen at the analyzer's 10.7MHz IF. External components are not supplied as part of the option.

It is important to minimize the SSB phase noise of the external LO to avoid generating noise contribution through reciprocal mixing between the LO and the TETRA TX input signal. Tests have shown that

to achieve reliable results, the LO SSB phase noise should be better than -155dBc/Hz at 5MHz offset and -133dBc at 100kHz offset.

With an appropriate LO frequency setting, the analyzer can be instructed to synchronize to the TETRA carrier with a single key press. In addition to setting a timing reference, the analyzer's synchronization process measures the

amplitude of the carrier to act as a reference point for the measurement.

The next step in the measurement process is to make a noise measurement by retuning the external LO frequency to mix the noise sideband of interest to the center frequency of the external IF. For each frequency offset specified, the noise power is averaged across 20 data blocks that have been captured synchronous to the transmitter burst.

Results

The noise floor of the measurement system depends on both the analyzer and the specification of the external IF, as shown in Table 3 above. These results show that the enhanced setup always gives at least 10dB headroom between the ETSI specification and the measurement noise floor. ■

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Understanding digital geometry



When purchasing a digital radio system, it is important to know how the system performance is characterized. Not all modulation schemes are created equal.

By Stephen Bartlett

Designing a digital radio system can be challenging, especially with transmitter power limits and bandwidth restrictions imposed on modern wireless systems. These restrictions can influence the radio's modulation design—particularly when a large quantity of data is transmitted over a narrowband channel.

The most critical modulation design parameter is *encoded symbol separation*. When several encoded symbols (M) are needed in a narrow bandwidth application, they should be carefully separated to minimize the cross-correlation—or symbol overlap—between them, defined as the *cross-correlation metric* (ρ). A well-designed symbol separation ensures that a system will have a consistent performance and operating range without demanding excessive transmitter power.

Orthogonal symbol sets are

necessary to achieve optimal symbol separation. To clarify, imagine that the modulation symbols are vectors in a geometric signal space. Each symbol has its own *vector magnitude*, or bit energy (E_b), and direction with respect to other symbols being transmitted. When the angle (ϕ) between any two of these vectors is 90° , the symbols are *orthogonal* (perpendicular). The cross-correlation metric is equivalent to the cosine of the angle (ϕ) between any two symbol vectors, $\rho = \cos(\phi)$, with values of $-1 \leq \rho \leq +1$.

This geometry can be easily visualized with a four-symbol ($M=4$) *quadrature phase modulation* design. When the symbols are orthogonal, each occupies a point at the center of the quadrant of a phase circle, separated by 90° . With *frequency-shift keyed* modulation, however, this analogy does *not* apply. Each FSK symbol has a unique frequency, with some spectral

overlap between adjacent symbols in the set. These overlapping FSK symbols will be orthogonal only when the maximum signal level of one symbol waveform occurs at the zero-crossing of another, as shown in Figure 1 on page 44. Two FSK symbols are orthogonal when separated by a specific frequency (R_s) determined by the multiple inverse of the symbol period (T_s). For coherent FSK systems, orthogonal separation occurs at $R_s = 1/(2T_s)$. For noncoherent FSK systems, this separation is $R_s = 1/T_s$.

Accounting for RF environment

If symbols are transmitted one at a time, non-simultaneously, why does this overlap matter? To detect symbols, a digital receiver

Bartlett is a wireless systems engineer and consultant for terrestrial and space applications. His email address is bartlett@erols.com.



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SRM-25	20	25	3 1/2 x 19 x 9 1/2	6.5
SRM-30	25	30	3 1/2 x 19 x 9 1/2	7.0

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SRM-30-2	25	30	3 1/2 x 19 x 9 1/2	11.0

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Performance

will correlate the energy of the phase, frequency or amplitude, depending on the modulation scheme. This is a straightforward process when the symbol energy is well above the noise—there will be few errors in choosing one symbol from another. However, in a low-signal, high-interference environment, this gets difficult, unless enough separation exists between symbols to make the proper choice.

The description of a simple FSK receiver's operation is useful for illustrating how symbol cross-correlation can degrade link performance. A symbol is received when its specific frequency detector has more energy output than noise coming from the other detectors. Within each symbol period, the detectors build to a maximum, then gradually decline, due to *filter hysteresis*, holding some energy into the next symbol period. When signals are weak compared to noise, this creates an uncertainty in

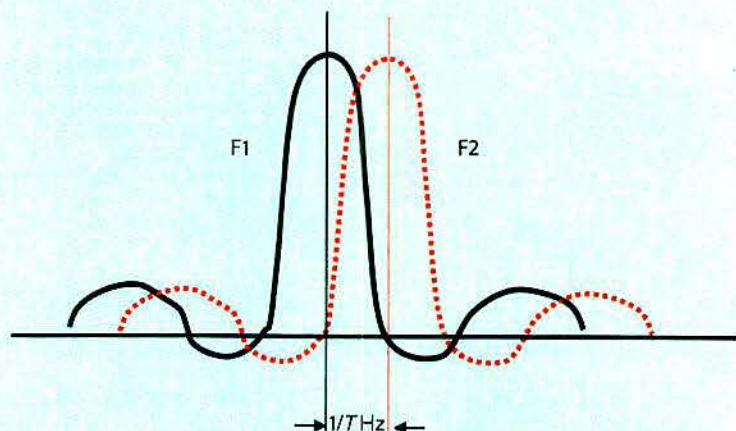


Figure 1. Adjacent FSK orthogonal symbols with a symbol rate $R_s=1/T$ Hz. (Noncoherent receiver detection case.)

the receiver's ability to choose which detector has the peak symbol energy during each sample period—especially if these symbols are close together with a large spectral overlap.

Symbol separation is a key parameter for predicting the probability of bit error (P_b) of a digital system. This P_b is calculated using the statistical Q function to relate the

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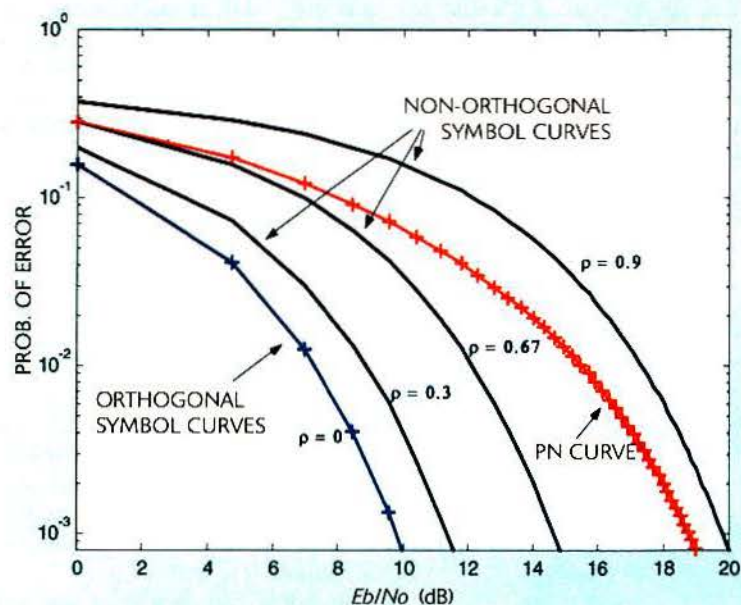


Figure 2. Average BER curves for different values of ρ .

cross-correlation and bit energy-to-noise ratio (E_b/N_o) (neglecting interference) to the bit error performance (BER):

$$P_b = Q\left(\sqrt{\frac{E_b(1-\rho)}{N_o}}\right)$$

The Q function is maximum, $P_b = 1/2$ (50% errors), when its argument is zero (no signal), and approaches its minimum value (almost zero errors) when the signal is much greater than the channel noise. The ρ metric in the equation scales the E_b/N_o ratio up or down, as determined by the symbol separation, and adjusts the Q function's argument, improving or degrading P_b . Binary antipodal symbols ($M=2$), like BPSK, have a maximum symbol separation angle of 180° ($\rho = -1$) that scales the E_b/N_o ratio by a factor of 2 and improves the P_b .

BPSK antipodal modulation has one of the best P_b performance curves in digital design because of this large symbol separation. For multiple symbol schemes, however ($M>2$), optimal separation is defined when all symbol vectors are *mutually orthogonal* ($\rho=0$). For FSK systems, mutual orthogonality requires critical spacing that increases the bandwidth by the

number of symbols times the symbol separation frequency ($M \times R_s$). For this reason, mutually orthogonal FSK designs are not feasible in narrow bandwidths.

If all the symbols cannot be orthogonal, then at least they should be consistently spaced to minimize differences between the ρ metric values. Large spreads of ρ values degrade system performance. This can be illustrated by modeling a set of BER curves using test patterns consisting of chosen symbol pairs, or pattern duets (as opposed to pseudo-random noise [PN] symbols). Each pattern duet generates a BER performance curve that, compared to an ideal orthogonal curve, can measure the effect these cross-correlation values have on the system.

When orthogonal symbols are tested in this way, each of the pattern duets has identical BER curves—each laying on top of the ideal orthogonal curve as shown in Figure 2 above, labeled $\rho=0$. When nonorthogonal symbols with large spreads of ρ values are tested in this way, the pattern duets will have different BER curves—each stretching farther from the ideal orthogonal curve as their ρ values approach +1.



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Consider a specific case of a noncoherent, $M=4$ FSK digital modulation scheme designed for a narrowband channel. Each per-symbol frequency is modulated by $k \times 600\text{Hz}$ ($k = \pm 1$ and ± 3) resulting in the symbol set ($\pm 600\text{Hz}$, $\pm 1,800\text{Hz}$) transmitted at a rate of 4800 baud. If this symbol set were

orthogonal, the difference between any two symbols ($k_i - k_j$) would be equal to an integer multiple of the symbol rate: $(k_i - k_j) = n \times 4800$. Because no two symbols satisfy this condition, it is clear that this 4-FSK example is nonorthogonal.

There are three values for the frequency spacing between these

symbols: 1,200Hz, 2,400Hz and 3,600Hz, with three ρ metric values: 0.9, 0.67 and 0.3, respectively. It is interesting to note that the lowest ρ value corresponds to the largest symbol spacing (3,600Hz) between the $\pm 1,800\text{Hz}$ deviation points. This design case was used to generate the set of nonorthogonal pattern duet test curves with the large spread of ρ values labeled in Figure 2. When this nonorthogonal system is tested using the standard PN test pattern, the red PN curve in Figure 2 results, showing a system performance several decibels poorer than ideal. This specific-case 4-FSK-modulation design suffers a degraded BER system performance due to its varied nonorthogonal ρ values.

In a Rayleigh-faded channel, the BER performance predictions use the equation:

$$P_{b-\text{faded}} = Q \left[\sqrt{\frac{E(\alpha^2)E_b}{N_o}} \right]$$

where $E(\alpha^2)$ is the Rayleigh-fading term. This Rayleigh term predicts performance degradations similar to the $(1-\rho)$ cross-correlation term. Therefore, nonorthogonal systems like the 4-FSK example above may have static BER performance curves similar to the faded-channel performance of an ideal orthogonal system.

Applications to system purchase

Buyers should know how the performance of any prospective digital system is characterized. It's unrealistic to expect the performance of a nonorthogonal modulation design to be predicted from the standard orthogonal symbol performance curves found in textbooks and industry references. This is especially important when considering narrowband FSK modulation systems having $M > 2$ symbols.

When analyzing such systems, be wary of those with unequal symbol separations having several ρ values greater than zero. Such modulation schemes can suffer from reduced link performances when passing typical random data patterns. ■



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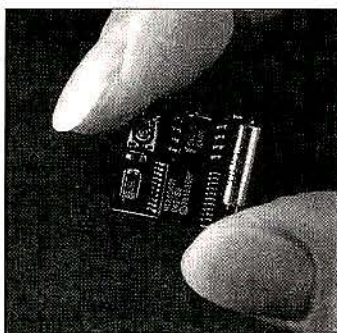
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CIRCLE (37) ON FAST FACT CARD

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www.ControlSignal.com

Control Signal's ID-12/1201 is an economical MDC-1200 ANI system. The ID-12 encoder works in all radios and fits in virtually all handhelds and mobiles. The ID-1201 decodes any MDC-1200 ANI signal, has a large LED display, a printer port and an RS232 port.

MDC-1200 is a registered trademark of Motorola Inc.

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CIRCLE (38) ON FAST FACT CARD

The Wizard of Oz and Bill

Many two-way operators and technicians, in commercial operations and in public safety, owe their start in the business to their roots in amateur radio. Here's one way to give a little back and pick up a tax credit at the same time.

By Joe Phillips

There is a big distinction between Bill Ake and the Wizard of Oz, and let's hope it stays that way. It may not.

Dorothy and Toto discovered that the Wizard was a blowhard who was pulling levers and making much useless noise without any significance. Bill Ake, W8PRH, a Fairfield, OH, amateur radio operator, also has levers (actually multiple, linked radio stations), but his noise is of great significance to two-way mobile-equipped travelers in the states of Indiana, Ohio and Kentucky.

It is known as the "Mighty 190" operating on 145.190MHz—simply a system to allow automobile travelers in those states (traveling salesmen, skilled laborers and truckers) to communicate with each other from their vehicles as if all were in the same room instead of being scattered across the map of the Midwest.

The "Yellow Brick Road" in Bill's kingdom (where all this takes place) spans the areas crossed by three interstates (I-75 and I-71 in Ohio and Kentucky plus half of I-74 in Indiana).

From a single transmitting tower in northwest Cincinnati, Bill's system links 11 other transmitting and 44 receiving stations, dotted throughout the three states, to make it happen. The entire system is operating on amateur radio frequencies, and one needs a ham radio license to participate (but nothing but a receiver is needed to listen in on 2m frequencies).

Simply put, a Mighty 190 participant crossing I-480 near Cleveland-

Hopkins airport can discuss the weather (or traffic, or politics or the Indians) with a similar equipped mobile traveler in Lexington, KY. Need power? No, 10W to 15W will do. Need a huge antenna? No, not for either vehicle.

First, of course, this system is no ordinary mobile communications repeater system—a fact noted even in the national magazine for amateur radio, *QST*, in April 1996. The "Fairfield Wide-Area System" (its official name) uses links, some with microwave technology, located in numerous volunteer and commercial tower locations, to create the largest multilink repeater system in the United States. Similar systems exist in San Diego County in California, the Washington-Baltimore corridor in the nation's capital, Long Island, NY, and between Los Angeles and San Francisco. None of these systems have anywhere near the complexity or infrastructure of Bill's "Mighty 190."

Much of the equipment is donated commercial equipment, mainly General Electric Mastr II or Motorola Micor-Motrac mobile and base station units retuned to the amateur frequencies in the 2m band. These top-notch electronic radios make the system easy to maintain, so it has little or no downtime. (Spare parts are more available for commercial-grade units than for amateur-only radios.) This is extraordinary, considering the size of the system, the number of working locations and considering that it's staffed by full-time volunteers. Operations are also made possible by thousands of hours of donated time by numerous hams for maintenance and monitoring.

Now, what's the problem?

The system grew from the early 1980s without either a permanent financial system or a regular system for acquiring spare parts and new repeater stations. The chief sponsor, the Fairfield Amateur Radio Association, does not have a dues system and does not want to start one.

Since 1982, the system has existed exclusively on voluntary contributions, and everyone wishes this arrangement to continue. In the past, many voluntary contributions came from ham radio events such as the famous Dayton Hamvention. At one point last year, the system had but \$400 in the bank when normal monthly expenses were more than \$1,350 in utility, maintenance and insurance costs. That's quite a squeeze.

An additional, and even more troublesome, problem is obtaining additional replacement transceivers and spare parts. As the system gets older, replacement units are needed. Remember that all equipment now in service consists of the reused and retuned commercial units Bill first obtained.

Therefore, the call is out for those with transceivers and spare parts (for example, parts for GE Mastr II radios, those that operate in the 450MHz range). Please contact FARA, at P. O. Box 40473, Cincinnati, OH 45240. As always, such donations are tax deductible.

Remember, the big distinction between Bill Ake, W8PRH, and the Wizard of Oz is that Bill's system works. ■

... the Wizard was a blowhard who was pulling levers and making much useless noise without any significance.

Phillips, K8QOE, a federally licensed amateur radio operator for 42 years, is the elected Section Manager of Ohio for the American Radio Relay League. He lives in Fairfield, OH.

Antenna features non-staining rubber cushion

Antenex's TMGPS trunk-mount antenna combines GPS and mobile communications in a system that provides the user with two-way communications capabilities and a GPS receiver. The Micro GPSx receiver is a durable antenna with 27dB active reception, allowing the user to pinpoint his location using the GPS system. By combining the antenna with an industry-standard NMO mount, the

system can be used for a variety of two-way communications scenarios. A non-staining neoprene rubber cushion under the mount ensures that it will not stick to or stain a vehicle's finish. This cushion also isolates the mount against vibration, providing a firm and lasting fit to the trunk lid. Made of type 302 stainless steel, the bracket features a design that enables it to be mounted to most new high-tolerance trunk lid seams. The mount features a low-profile design and may be easily removed.

WWW.ANTENEX.COM



Antenna provides GPS in small package

The low-profile GPS/cellular Mercury antenna from Centurion Wireless Technologies delivers GPS tracking and omnidirectional cellular coverage in a package less than 0.675" high. The antenna is for external use on commercial

vehicles for tracking applications and is housed in a radome suitable for a commercial trucks or similar vehicles. The antenna comes with cables and RF connectors for any GPS/telecommunications package.

WWW.CENTURION.COM



Glass-mountable antennas complement vehicle's appearance

The CL35 glass-mountable Euro style compact antenna from Antenna World complements a vehicle's appearance. This series provides 2.1dBi of gain at

800MHz or 900MHz. The patented coupler provides thru-glass signal transfers. Other whips are available for 3dB, 5dB and 7dB of gain for these bases. Kits include cable and any connector.

WWW.ANTENNAWORLD.COM

Antenna combines GPS with trunking

Model ASP-1860TGPS from Antenna Specialists is a 3dBd gain rooftop mounting antenna that combines active GPS location with broadband trunking or cellular capability for complete frequency coverage without tuning. The

antennas can be installed on transit, construction, police or emergency vehicles as well as applications that include tracking programs for fleet equipment management. They can be installed using an existing 3/4" hole. A weather-proof ultrasonic seal and O-ring at the mount interface protect against extreme weather conditions.

WWW.ANTENNA.COM



Antenna offers 2.1dBi gain

The CLR-9001 patch-style antenna from Antenna World is 1" x 4" and 1/8" thick and offers

2.1dBi of gain. It is designed for hidden installations in vehicles. The CLR-9002 antenna uses double-shield RG-174 throughout the full 10' length.

WWW.ANTENNAWORLD.COM



Trunk antenna supports satellite apps

The Constellation series long-haul truck antenna from Antenna Specialists is designed for use with XM satellite radio receiver hardware. Optimized for tractor-trailer installations, this design is ground-plane-independent and may be mounted on "west coast" mirrors

up to 1/2" OD to 1.188" OD tubes. The XM5000 is engineered to meet XM satellite radio specifications for mobile antennas. Each antenna is supplied with cable and connectors to accommodate terrestrial and satellite hook-up to the XM receiver module. The antenna is 48" long including the mirror bracket, and it weighs 34 ounces including the bracket and mounting hardware.

WWW.ANTENNA.COM

GPS antenna offers compact design

Radiall/Larsen Antenna Technologies' GPSTM antenna is designed for asset tracking and AVL applications. Its dimensions are 0.5" height and 1.7" x 1.7" square. The antenna provides a low profile by mounting directly to the vehicle with a trunk mount bracket. It features an active GPS module with an LNA gain of 28dB.

WWW.RADIALLLARSEN.COM

Company	Page Number	Fast Fact Number	Advertiser Hotline	Company	Page Number	Fast Fact Number	Advertiser Hotline
Acess Comm	61	114	514-735-5248	Modular Communications Sys. 21	18	818-764-1333	
AeroComm	7	8	201-227-0066	Motorola	19	16	708-538-6333
Air Comm	57	111	602-275-4505	Motorola Test Equipment	9	10	800-505-TEST
Alltec	46	37	800-203-2658	Multiplier Industries	27	23	914-241-9510
The Antenna Specialists	24	21	440-349-8400	Norcomm Corp	12	41	800-874-8663
Astron Corp.	43	24	949-458-7277	OpenSky	1	4	877-OPENSKY
Avtec, Inc	33	25	803-892-2181	Peltor Communications	IBC	2	317-692-6666
Barnett	58	106	800-423-3858	Pirod	40	30	219-936-4221
Berkeley Varitronics	11	11	908-548-3737	Polaris	58	104	404-872-0722
Cadex Electronics	39	29	604-231-7777	Pryme Radio	52	27	714-257-0300
David Clark Co, Inc	51	40	508-751-5800	Pyramid Communications	60	108	714-901-5462
CMC Enterprises	61	113	336-769-2885	AVCom /Ramsey	61	110	800-446-2295
Comms. Specialists	BC	3	800-854-0547	RCC Consultants Inc.	63	116	732-404-2400
Control Signal Corp.	46	38	800-521-2203	RF Imaging and Comms	61	112	925-229-2034
CPI Communications	44	34	972-429-7160	Sacramento Comm	62	115	209-755-4949
Crescend Technologies	50	39	800-872-6233	SCA	41	32	800-627-4722
Daniels Electronics	45	36	604-382-8268	Simulcast Solutions	56	103	716-223-4927
Datron World Comms.	25	22	760-597-3814	Sinclair Technologies	38	33	905-727-0165
Decibel Products	13	12	214-819-4281	SoftWright	60	109	303-344-5486
DLC	8	9	562-404-9998	Swager Communications	59	101	800-968-5601
Duracomm Corp.	40	31	816-472-5544	Telewave Inc.	5	6	650-968-4400
El Paso Comm. System	56	107	915-533-5119	Thunder Eagle	44	35	703-242-0122
Emerson & Cuming	59	100	781-961-9600	TPL Communications	22	19	323-256-3000
EML	58	105	615-771-2560	Transcrypt International	20	17	800-894-2609
Futurecom	37	28	905-860-5546	TX RX	3	5	716-549-4700
ICOM America	23	20	206-450-6041	Vega/Telex Signaling	6	7	402-467-5321
Iridium	15	13	866-947-4348	VERTEX/YAESU USA	IFC	1	310-404-2700
Klein Electronics	56	102	760-781-3232	W & W Manufacturing	35	26	800-221-0732
MCM Technology	18	15	205-655-0004	Zetron	17	14	425-820-6363

CORRECTION: In the September 2001 and October 2001 issues of *Mobile Radio Technology*, the featured product in NorComm's advertisements, the NC804 Voice Plus encryption scrambler, had the wrong price listed. The ad listed the price as \$119.95, when it should have listed as \$129.95. The ads appeared on page 38 in the September issue and on page 32 in the October issue.

Portable GPS technology available



The Radiotrac for hand-held, two-way radio systems from **CyTerra** is portable. The system provides instant location and emergency tracking information through a customer's existing mobile or hand-held two-way radio system. All systems

come complete with a base station, miniature GPS transceiver and mapping software.

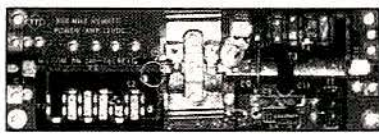
WWW.CYTERRACORP.COM

App sends, receives graphics, text

AVeL-TECH's MobiCAD is an in-vehicle Windows AVL application that provides basic position reporting and displays real-time maps with messaging. The mobile user is provided with a seamless data path to the dispatch center, with the ability to send and receive graphic or text information.

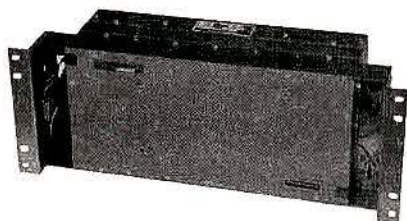
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540-061 K45 850-870 MHz 45 Watt Replacement Module

850-870 MHz Module



P-Series Amplifiers Available in:

- VHF Low Band
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Crescend Technologies, LLC

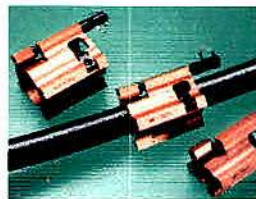
Phone: 800 872 6233 Fax: 847 593 1320

www.CrescendTech.com email: sales@crescendtech.com

CIRCLE (39) ON FAST FACT CARD

Product Encore

Midspan strip tools work for LMR cables



Four midspan strip tools are available from **Times Microwave Systems** for use with LMR feeder cables sizes

600 through 1700. The GST-600A, 900A, 1200A and 1700A tools provide a way to remove the outer polyethylene jacket on LMR feeder cables to prep the cables for attaching ground kits. Made from aluminum with a steel blade, each tool is sized to remove the jacket without damaging the underlying coax cable shield.

WWW.TIMESMICROWAVE.COM

Combiner/divider provides isolation



Narda's SMA power combiner and divider features isolation and low insertion loss throughout its frequency range of 1,900MHz-2,500MHz. Model 4162 is available from stock in eight-way and 16-way versions.

WWW.DEPT26.COM

Assemblies meet requirements



The custom fabricated standard and high-power RF coaxial cable assemblies from **Tru-Connector** are manufactured to meet special application and environmental requirements. Available in sizes 0.100" to 1.20" O.D. up to 150' long in semirigid and high voltage types, they are rated at 50Ω or 75Ω from dc to 18GHz.

WWW.TRU-CON.COM

Equipment simplifies administration

Positron's Simon combines the advantages of traditional telephone-based 9-1-1 call-taking consoles and computer telephony integration into an ergonomic, all-in-one unit that is simple to install, simple to use and simple to manage. This product requires little user training and simplifies system administration. It integrates with Positron's Life Line 100 E9-1-1 ANI/ALI controller, ensuring a redundant system with no single point of failure.

WWW.POSITRON911.COM

Connectors feature Teflon insulation

The RSA-3000-I connector from **RF Connectors** is designed for simple assembly and crimp installation when used with Times Microwave LMR-400, Belden 78-10A or Belden 9913 low-loss RG-8/U type cables. SMA connectors are used in high-frequency and microwave applications where small size and performance are required. This straight crimp plug features Teflon insulation, gold-plated contact and a nickel-plated body. Other SMA crimp connectors are available for RG-174/U, RG-142/U and RG-8X low-loss cables from Belden, CommScope and Times Microwave.

WWW.RFINDUSTRIES.COM

Receiver generates four alarm sounds

The Informer is a radio receiver from **Federal Signal** that instantly alerts and notifies the public of emergency situations. This product can generate four separate alarm sounds. The receiver features a

flashing LED panel to indicate an emergency alert has been received. Other features include a low battery indicator, built-in diagnostics and a test indicator LED.

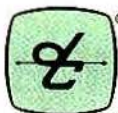
WWW.FEDERALWARNINGSYSTEMS.COM

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Two-way communication in high noise environments is difficult and possibly hazardous. Now you can communicate clearly and protect your hearing in high noise areas with a simple communication system from David Clark. Just add our Noise Attenuating Headsets and Radio Adapter Cords to enhance the performance of your two-way radios. Our high quality headsets feature rugged construction and a certified Noise Reduction Rating (NRR) of 24 dB. They're available in Over-The-Head or Behind-The-Head styles for use with safety caps and helmets. Boom mounted or throat microphones enable hands-free performance. Choose Voice-Activated (VOX) or Push-To-Talk (PTT) systems with adapter cords for over 300 two-way radios. For clear two-way communication in high noise, there's only one name worth repeating — David Clark.

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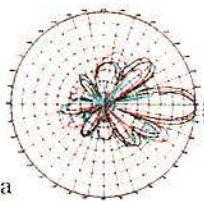
CIRCLE (40) ON FAST FACT CARD

Antennas offer signal focus

Varitilt antennas from **Decibel Products** now feature reduced co-channel interference, increased pattern control and precision in signal focus. Model 894H65VTR-SX provides a top-fed connector with field-selectable downtilting

to as much as 10°. It is 2.8' deep and suitable for mounting flat to a building or wall.

WWW.DECIBELPRODUCTS.COM



Two-way radios feature 32-channel memory

Kenwood's TK-272G/372G UHF/VHF hand-held two-way radios come with a Kenwood charger, high-capacity 100mAh NiCd battery and a metal-spring belt clip. The radios offer a 32-channel memory capacity, priority scan and integrated QT and DQT signaling. The portables meet the Mil-Std 810 C, D and E for shock vibration, humidity and rain.

WWW.KENWOOD.NET



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Base station uses space efficiently



The 2601 series digital repeater/base station from **EF Johnson** offers dual-mode operation and meets the requirements of Project 25 digital operation and TIA 603 analog operation. A five-channel repeater, combiner, duplexer and multicoupler can fit in one eight-foot standard rack.

WWW.EFJOHNSON.COM

Software displays system configuration

The InFielder PDA software from **Wireless Valley Communications** is for the Palm IIIc. The software displays the physical location and configuration of wireless system infrastructure equipment, such as antennas, cabling and wiring within 2D and 3D drawings or maps of any in-building or campus environment.

WWW.WIRELESSVALLEY.COM

CIRCLE (27) ON FAST FACT CARD

November

6-8: Canadian Wireless, sponsored by the Canadian Wireless Telecommunications Association, Metro Toronto Convention Center. Contact: 613-233-4888, ext. 102, or www.cwta.ca.

6-11: Communications Marketing Conference, DoubleTree Hotel Tucson-Reid Park, Tucson, AZ. www.commktga.com.

12-15: AMTEX 2001, sponsored by the American Mobile Telecommunications Association, Wyndham Miami Biscayne Bay, Miami. Contact: 202-331-7773. www.amtausa.org.

12-15: IWTA 2001 Expo, sponsored by the International Wireless Telecommunications Association, Wyndham Miami Biscayne Bay, Miami. www.iwta.org.

16: Radio Club of America Annual Awards Banquet and Technical Symposium, New York. www.radio-club-of-america.org.

27: Region 13 National Public Safety Planning Advisory Committee meeting, 10 a.m., Illinois State Police Communications Services Bureau Administrative Office conference room.

Contact: George Sneyd at 217-782-5382 or sneydgc@isp.state.il.us.

27-28: NENA/APCO Wireless 9-1-1 Joint Forum, Dallas. www.apco911.org.

2002

February

19-22: NATE, sponsored by the National Association of Tower Erectors, Orlando, FL. Contact: 888-882-5865 or www.natehome.com.

March

7-10: Entelec 2002, George R. Brown Convention Center, Houston. www.entelec.org.

18-20: Wireless, sponsored by the Cellular Telecommunications Industry Association, Orlando Convention Center, Orlando, FL. www.wow-com.com.

April

24-26: International Wireless Communications Expo, co-sponsored by *Mobile Radio Technology*, Las Vegas Convention Center, Las Vegas. www.iwceexpo.com.

25: Simulcast Forum, Simulcast Solutions, Las Vegas Hilton, Las Vegas. www.simulcastsolutions.com.

June

2-6: Supercomm, sponsored by TIA and USTA, Georgia World Congress Center, Atlanta. www.usta.org/supercomm.

16-20: NENA, sponsored by National Emergency Number Association, Indianapolis. www.nena9-1-1.org.

23-26: UTC Telecom, sponsored by UTC, the United Telecom Council, MGM Grand, Las Vegas. www.utc.org.

August

11-15: APCO Conference & Exposition, sponsored by Association of Public-Safety Communications Officials-International, Opryland Hotel, Nashville, TN. www.apcointl.com.

September

17-20: PCIA GlobalXChange, sponsored by the Personal Communications Industry Association, New Orleans. www.pcia-expoventure.com.

Changing Channels



Barkman

Changes at Sabre Communications, Sioux City, IA:

Dean Barkman advances to operations manager, pole division. **Jaime Figueroa** leaves Valmont Industries, Omaha, NE, as regional director Latin America and Caribbean to join Sabre as vice president of international sales. **Brian Newberg** becomes national sales manager.



Figueroa



Newberg

Nigel Moore departs Panorama Antennas UK as international sales manager to join Times Microwave Systems,



Whipple

Wallingford, CT, as international sales manager of telecomm and wireless products.

Dennis Whipple joins the board of directors of Orland Park, IL-based

Andrew after retiring in April from Evercom Communications, Irving TX, as chief executive officer.

John Kelly, chief operating officer of Crown Castle International, Houston, moves up to chief executive officer.

David Hattey, senior vice president of EF Johnson, Waseca, MN, advances to president and general manager.

Tom Malone, a managing director at Chase Securities, departs to join Daniels & Associates in New York as senior vice president of

the private capital group.

Changes at Vertex Standard, Cerritos, CA:

Scott Henderson joins the company as vice president of the land mobile radio division. **Stan Scott**, national sales manager, is responsible for all sales in the United States and Canada. **Jim Driscoll**, government sales manager, is handling the bids and quotes management function for the LMR division. **Richard Galvan** advances to product development/technical sales training manager.

Christian Engsted departs ABB, as president of Industrial Products to join SeaWest WindPower, San Diego, as president.

Don Thoma leaves Diamond-Back Vision, Reston, VA, as vice president of marketing and business development to join Iridium, Leesburg, VA, as vice president, business development.

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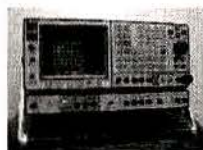
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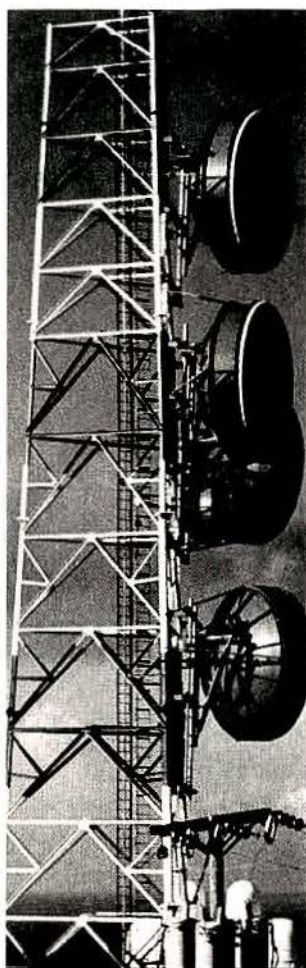
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70a	SYNTRON X 9000, 400MHz, T74KEJ7J04AK
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50a	RADIUS M120, 460 MHz, M44GMC20A3AA
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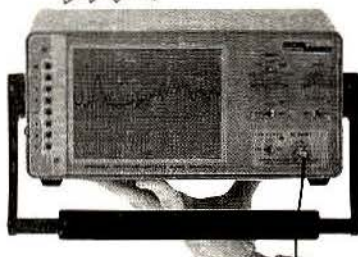
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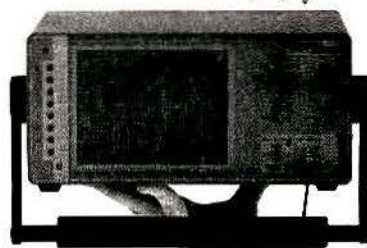
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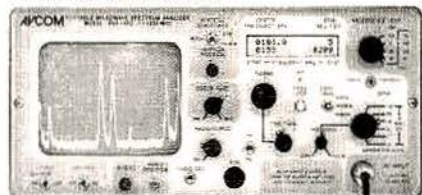
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To everything, there is a season...

This year, I eagerly planned my wife's birthday celebration. Judy and I have been married for more than 30 years, and I've found it is getting harder to surprise her.



In the past, I have arrived in a gorilla outfit at a law office where she worked. (Lawyers need to get a sense of humor.) I

kidnapped her from the technical college she teaches at for a week-end adventure, and I have surprised her with a number of other "Roger specialty" events.

This year I decided to put my efforts into getting a nice gift and making a fine dinner. (Another Roger secret revealed—I'm a good cook.)

Judy's birthday is Sept. 11. Her birthday will never be the same again.

'Ground zero' in New York is now being referred to as 'ground hero,' and rightfully so.

We did the best we could with the birthday celebration but found ourselves in front of the television like most Americans.

Late that night I picked up one of my guitars and I started to play the Byrds' "Turn, Turn, Turn," adapted from Ecclesiastes. While watching the events on Sept. 11 unfold, I found myself reflecting on the song during the day, and a couple of verses in particular:

*A time to plant, a time to reap.
A time to dance, a time to mourn.
A time to cast away stones
A time to gather stones together.*

*A time of love, a time of hate
A time of war, a time of peace*

The words seemed to fit my emotions and mood following the day's events.

Events changed everything

As the stories unfolded, I

thought of our son Ben. Ben worked a block from the World Trade Center not too long ago. Now a newspaper reporter in New Jersey, he watched from his office window as the first tower collapsed. His telling me this caused me to pause and say a prayer for his safety and for those in the towers. As he told me about what he saw, I reflected back to two years ago when I stood with Ben, my wife and my daughter Carly, at the top of one of the towers. We marveled at the view and splendor of New York. I even took a picture of the shadows the towers cast across Manhattan. The shadows are now gone forever.

The attack on the Pentagon also struck home with me. As you may know, I'm a retired U.S. Air Force lieutenant colonel. When I heard of the attack on the Pentagon, I was immediately brought back to the time I spent in those hallowed halls. The best and the brightest our country, and our military, has to offer make it to that building. Now, many have lost their lives in defending our freedoms.

Amateur radio

When I was on active duty, I was amazed at how amateur radio operators supported the military. The Military Affiliate Radio System members are volunteer, licensed amateur radio operators. In times of emergency, and even on a daily basis, they really step up and assist.

It was no different during the tragic events of Sept. 11. My thanks to Dale G. Svetanoff (WA9ENE) of Rockwell Collins for drawing my attention to the efforts of amateur radio operators in New York. Dale emailed me a copy of an item that appeared in the *ARRL Letter* of Sept. 21. According to the newsletter, dozens of hams worked 12-hour shifts to cover communications and logistical support for the American Red Cross and provided supplemental communications for the New York City Office

of Emergency Management.

According to Tom Carrubba (KA2D), New York City-Long Island ARRL section emergency coordinator, a single, multipurpose ARES/RACES net was maintained on a 147MHz repeater in Manhattan. Carrubba also stated that the volunteers came from the greater New York City area and were deployed to 13 Red Cross shelters, two OEM sites and several staging areas. Others are stationed just outside the WTC scene.

In the 10 days following the attack, more than 350 amateur radio volunteers provided in excess of 5,000 work hours.

Ground hero

"Ground zero" in New York is now being referred to as "ground hero," and rightfully so. We've seen the heroic efforts of the police, fire departments, EMTs and others at both attack sites. Now include amateur radio operators.

Following the Battle of Britain, Winston Churchill told the British people that never have so many owed so much to so few (referring to Royal Air Force pilots). His words are appropriate today.

We, who feel so helpless, can look with pride on the few. They are heroes in every aspect of the word. But you and I can be heroes too. Start by thanking those who have helped. If you know the call sign of an amateur radio volunteer, let him know that you know what he did. In your community, donate blood, money and your time. Remember, no matter what the future brings, we are all in this together. And together we must stand and be counted.

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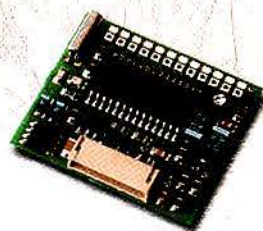
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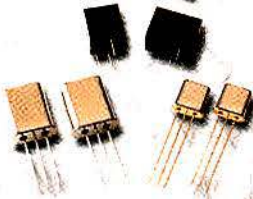
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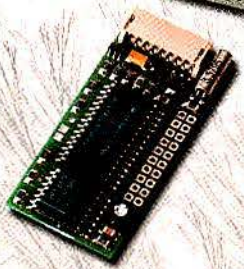
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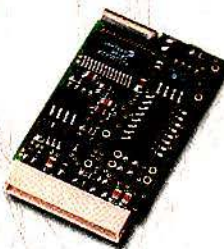
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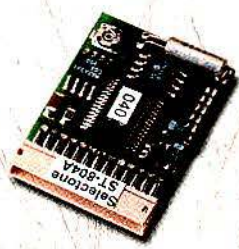
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